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NSC

Docklands showcases sustainability

Vol 19 No. 8 September 2011

University sports steel

Glasgow velodrome on track

Atrium forms school hub

Manchester's unique mill

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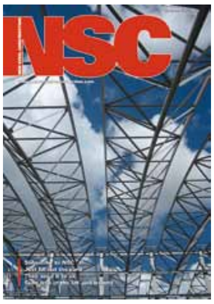

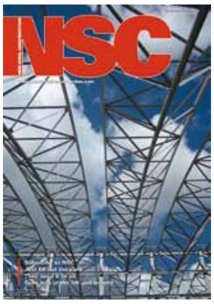

New Steel Construction keeps designers and contractors abreast of all major steel construction related developments and provides detailed technical information on key issues such as the introduction of the Eurocodes. NSC will be the first place most people hear about advances made by the extensive research and development efforts of the steel construction partners – Tata Steel, the British Constructional Steelwork Association, and the Steel Construction Institute, as well as other researchers.

Each issue of NSC is a blend of project reports and more in depth technical material. Taking up our free subscription offer is a guarantee that you will be alerted to significant developments in a sector that retains a commitment to continuous development in knowledge and techniques for timely delivery of cost effective, quality projects across all sectors of construction.

Each issue of NSC is typically 44 pages and contains five pages of news, developments related to Eurocodes, cutting edge project reports from site, and the latest technical updates from the Steel Construction Institute in its Advisory Desk Note series. Popular features are 50 Years Ago and 20 Years Ago, looking at key projects of the past by revisiting the pages of 'Building With Steel' and 'Steel Construction'.

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Cover Image
Lancaster University Sports Centre
Main Client: Lancaster University
Architect: Faulkner-Browns Architects
Steelwork contractor: The AA Group (TAAG)
Steel tonnage: 420t

NSC September 2011 Vol 19 No 8

These and other steelwork articles can be downloaded from the New Steel Construction Website at *www.new-steel-construction.com*


GEMINI
GEMINI


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Sustainable surprises from steel

Nick Barrett - Editor

The timing of the economy's full emergence from the post credit crunch and recession environment may be more uncertain than it seemed just a couple of months ago, but when construction's recovery does get properly under way there will be some pleasant surprises awaiting developers and other clients on the sustainability front.

The latest in the groundbreaking Target Zero series of low carbon design guides has just been published (see News), this one focussing on steel framed medium and high-rise office buildings. It shows convincingly that the 2010 Part L compliance target of reducing operational carbon emissions by 25% can be achieved by steel framed buildings using current best practice without any additional capital cost. This should bring some comfort to clients in this key sector of the market, a rare example of one which is showing signs of life, at least in London.

This is the fourth in a series that has already produced guides for designers of schools, warehouses, and supermarkets. The fifth guide, for mixed-use buildings, is under preparation and will complete the £1M Target Zero project being funded by Tata Steel and the BCSA.

These studies are not merely theoretical but are intended to provide designers with fully costed, practical information that they can use to support the government's zero carbon targets. The office developments study for example uses a ten storey building that has actually been constructed as a benchmark to investigate three priority areas of sustainable construction – operational carbon emissions, BREEAM assessment rating, and embodied carbon.

Steel construction routinely of course already produces highly sustainable buildings, as the large number of structures achieving high BREEAM ratings proves; the first office to be rated Outstanding in England is the steel framed 7 More London, a ten storey prestige building on the Southbank of the Thames in London occupied as a headquarters by international management consultants PricewaterhouseCoopers LLP.

Earlier guides have produced details of how designers can achieve significant energy savings, which are even more valuable now that energy prices have risen so fast since the first report in 2009. That report, on schools, identified potential annual energy savings of £165M annually by adopting straightforward measures.

Steelwork contractors are working towards their own BREEAM recognition, with one having achieved BES6001 (see News). There are fairly highly set bars to be overcome to achieve BES6001, just as there are for the BCSA's Sustainability Charter, and those who successfully tackle them are to be congratulated. For BES6001, for example, steelwork contractors have to prove that their policies, documentation systems, processes and procedures can manage the environmental and social aspects of sourcing materials. Supply chain management with a view to reducing environmental impacts must be demonstrated and commitment has to be shown to a range of sustainability issues like reducing greenhouse gas emissions, and managing water use.

Social issues are also very important to achieving BES6001, and steel contractors can easily demonstrate that steel construction with its mostly factory based workforce is inherently more supportive of family life than widespread use of itinerant workforces with other methods of construction.

The steel sector is already producing highly sustainable buildings and, as is seen with initiatives like Target Zero, is committed to continuously improving its sustainability performance – all we hope for now is a more sustainable economic environment in which these skills can flourish.

NSC

EDITOR
Nick Barrett Tel: 01323 422483
nick@new-steel-construction.com
DEPUTY EDITOR
Martin Cooper Tel: 01892 538191
martin@new-steel-construction.com
CONTRIBUTING EDITOR
Ty Byrd Tel: 01892 553143
ty@barrett-byrd.com
PRODUCTION EDITOR
Andrew Pilcher Tel: 01892 553147
andrew@new-steel-construction.com
PRODUCTION ASSISTANT
Alastair Lloyd Tel: 01892 553145
alastair@barrett-byrd.com
NEWS REPORTER
Mike Walter
COMMERCIAL MANAGER
Sally Devine Tel: 01474 833871
sally@new-steel-construction.com

CHANGES TO THE MAILING LIST
If you wish to notify us of a change:
Members BCSA and Non Members
Telephone BCSA on 0207 747 8131
Members SCI Telephone SCI on 01344 636 525

PUBLISHED BY
The British Constructional Steelwork Association Ltd
4 Whitehall Court, Westminster, London SW1A 2ES
Telephone 020 7839 8566 Fax 020 7976 1634
Website *www.steelconstruction.org*
Email *postroom@steelconstruction.org*

The Steel Construction Institute
Silwood Park, Ascot, Berkshire SL5 7QN
Telephone 01344 636525 Fax 01344 636570
Website *www.steel-sci.org*
Email *reception@steel-sci.com*

Tata Steel
PO Box 1, Brigg Road, Scunthorpe,
North Lincolnshire DN16 1BP
Telephone 01724 405060
Website *www.tatasteelconstruction.com*
Email *construction@tatasteel.com*

CONTRACT PUBLISHER & ADVERTISING SALES
Barrett, Byrd Associates
7 Linden Close,
Tunbridge Wells, Kent TN4 8HH
Telephone 01892 524455
Website *www.barrett-byrd.com*

New Director General designate arrives at BCSA

As of the 12th September Sarah McCann-Bartlett has taken up her role as BCSA Director General designate. She will replace Derek Tordoff in December, when he retires from the Association after 35 years, 27 of those spent at the helm.

Sarah McCann-Bartlett is an accomplished senior executive with 19 years experience, having spent the first half of her career in a trade organisation and the second half in construction.

Until 2001 she was President and Group Manager of Woolmark Americas where she was responsible for marketing strategies for the USA and Canada. Her role also focussed on R&D, specifically the commercialisation of new technologies and processes.

More recently, from 2001 to 2010, she worked for the Building and Plumbing Industry Commissions of the State of Victoria, Australia. Here she gained a deep understanding of the construction industry, particularly in her final role as Deputy Chief Executive/Commissioner.

Steelwork contractor achieves BREEAM accreditation

Severfield-Rowen has become the first steelwork contractor to achieve BES 6001 for BREEAM accreditation.

Forming part of the Company's overall 'Steel Futures' programme, which is aimed at achieving a safer, more sustainable zero carbon future, the achievement of BES6001 will allow clients, designers and architects to attain additional BREEAM points for using Severfield-Rowen products in their buildings.

breeam responsible sourcing

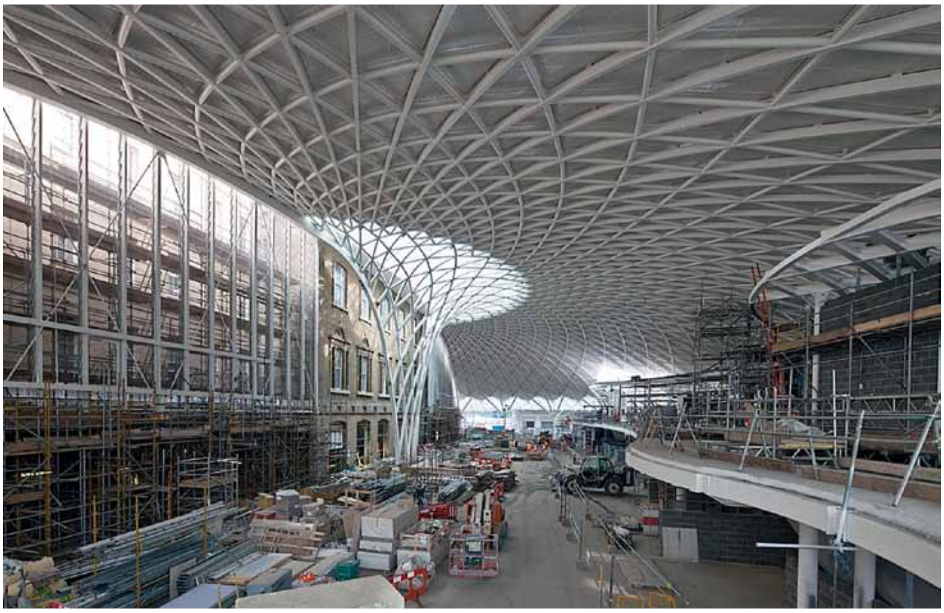
"BES 6001 raises Severfield-Rowen's capabilities and provides a significant market advantage allowing our clients and their projects to achieve BREEAM points in order to get the highest possible rating," said Dave Larter, Severfield-Rowen Group Director - Business Sustainability.

In obtaining BES 6001, Severfield-Rowen demonstrated that its policies, document systems, processes and procedures were in place to manage the environmental and social aspects relating to the sourcing of materials. The company also showed that it is actively managing its supply chain to reduce its environmental impact.

In addition, the company demonstrated that it has objectives and metrics for environmental issues including greenhouse gas emissions, water management and social issues including employment, skills, engagement and support of local communities.

"Severfield-Rowen is constantly engaged with its stakeholders to promote a more sustainable future," said Mr Larter.

King's Cross redevelopment on line



One of London's oldest and busiest train stations, King's Cross, is undergoing a large scale make-over to boost capacity, increase connectivity between mainline and underground train services and generally improve the travelling experience for the 50M passengers that use the terminus every year.

The centrepiece of the £500M redevelopment is a new steel vaulted, semi-circular concourse structure to the west of the existing station.

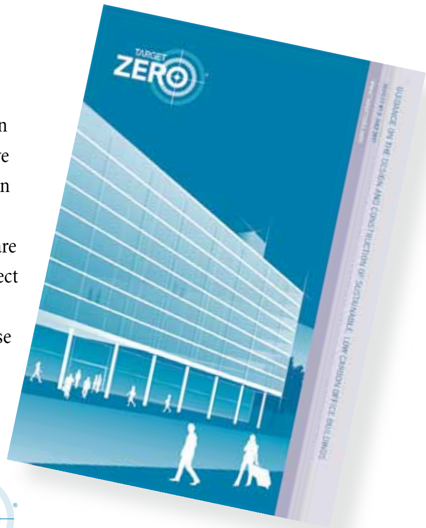
The steel framed structure rises some 20m and spans the full 150m-length of the Grade I Listed Western Range, creating a new entrance to the station through the south end of the concourse and at mezzanine level on the northern end.

Designed by John McAslan + Partners and engineered by Arup, the 7,500m^2 concourse has become Europe's largest single span station structure, comprising of 16 steel tree form columns that radiate from a central funnel.

All of the internal steelwork for the concourse, including the mezzanine level has been erected by Bourne Steel. The company has also completed a new train shed for King's Cross suburban services.

The new and larger station concourse is due to open in spring 2012.

Guidance targets zero carbon in office developments



The fourth of the five Target Zero guides, covering medium to high rise office buildings, has been published and is available for download in pdf format at *www.targetzero.info*

The report will be invaluable to those responsible for the design of offices and demonstrates that the 2010 Part L compliance target of reducing operational carbon emissions by 25% is readily achievable using current best practice and without incurring any additional capital cost.

The study uses a recently constructed office building as a benchmark, and investigates three priority areas of sustainable construction: operational carbon emissions, BREEAM assessment rating and embodied carbon.

The base case building for the report is One Kingdom Street, London. This is a Grade A steel-framed office building in the centre of London which was completed in 2008. The building accommodates 24,490m^2 of open-plan office space over ten floors; two basement levels provide car parking and storage areas.

The study undertakes a detailed comparison of different energy efficiency measures, low and zero carbon (LZC) technologies and allowable solutions in order to identify the most cost-effective means of achieving likely future carbon reduction targets.

Five non domestic building types are being analysed in the Target Zero project which is funded by Tata Steel and the BCSA. Guidance on a school, warehouse and supermarket have already been published, while the fifth guide on mixed use buildings will be published soon.

TARGET ZERO

Galvanizing keeps tall ships afloat

Glasgow-based Scottish Galvanizers, part of Wedge Group Galvanizing, has provided its hot dip galvanizing treatment to 100t of steelwork used to build 60 pontoons and two access bridges that were installed in Greenock for the prestigious Tall Ships sailing race, which visited the town in July.

"When the race last docked in Greenock in 1999, it attracted around 800,000 tourists to the area," said Paul Tait, Commercial Manager for Scottish Galvanizers. "This year's event brought in similar crowds, and we're proud to have played a part in the preparations and the construction of the new pontoons."

The Tall Ships race is an annual event that looks to bring together some of the most promising young sailing talent in Europe. Participating ships are manned by a mostly cadet or trainee crew, of which at least half must be aged between 15 and 25.

New bridge strikes a chord

Chetham's School of Music has achieved a significant milestone in its £36M redevelopment with the installation of a bridge to connect new 21st century facilities with the medieval site where the city of Manchester began.

Linking the heart of medieval Manchester with the future of music education, the footbridge will be the main thoroughfare for the School's 290 students every day. They will cross the bridge as they make their way from their sleeping and eating quarters, to the new school where they will study, practice and perform.

The bridge, fabricated and erected by Watson Steel Structures, crosses the River Irk and was designed as part of a joint venture between Manchester-based Roger Stephenson Architects and structural engineers Price & Myers. The companies applied aeroplane technology to the structure to ensure a lean and sculptural design and to compliment the elegant surroundings while adhering to strict planning restrictions.

Made from weathering steel, the bridge is designed to withstand the harshest conditions and endure years of continued heavy use as it carries Chetham's future generations for years to come.

AROUND THE PRESS

New Civil Engineer
28 July 2011
Column free at Cannon Street
"Having to feed in 21m long Fabsec beams through the side of the station in the dead of night was challenging," says Giles Fazan, Hines construction director.

The Structural Engineer
19 July 2011
The Convention Centre, Dublin
A structural steel solution was chosen primarily because of the long span/shallow structural depth imposed on the project by virtue of meeting the client brief and also keeping within planning constraints for building height, but also for programme reasons insofar as all the elements were fabricated off site and brought to site in a well managed and controlled sequence.

Construction News
28 July 2011
How to rebuild an operational airport
(Heathrow Terminal 2) To maximise speed and quality, the project team opted for offsite manufacture for the M&E while the 27,000 tonne steel frame is being fabricated and erected.

Building Magazine
1 July 2011
Is your green building really so green?
Canolfan Rheidol is typical of many recent good practice low carbon buildings. It is mixed mode, meaning it is naturally ventilated with backup mechanical ventilation and cooling for a very hot day or when the building gets stuffy in winter... It also features a steel frame.

Building Magazine
17 June 2011
King of King's
(King's Cross Station) The western concourse roof structure is formed from radial beams linked by diagonal members running from the edge of the concourse back to the west side of the station. The beams were supplied in sections as 'ladders' built offsite. These were delivered at night and welded together during the day.

First batch of wind turbines rolled out

Mabey Bridge has completed its first wind turbine towers from its state-of-the-art factory in Chepstow, with the towers now being delivered to wind farms in Yorkshire.

Mabey Bridge has invested £38M in the wind turbine venture and is currently the sole UK-based manufacturer of such towers. At full capacity the factory can produce 300 towers per annum.

Last year Mabey Bridge secured a preferred supplier agreement with REpower – one of the UK's biggest suppliers of wind energy. The firm is producing nine steel tubular towers for them. Each completed tower is 80m long, made up of three sections and weighs 150t. Five towers will be stationed at the Seamer wind farm in North Yorkshire while four will also go to the Marr wind farm in South Yorkshire.

Peter Lloyd, Managing Director of Mabey Bridge, said: "By rolling out the first completed batch of wind turbine towers we are sending out a clear message that we are open for business. It now means that companies in this country no longer have to import wind turbine towers but instead they can buy British."

Steelwork contractors form joint venture

Billington Structures and Bourne Steel have officially launched a joint venture known as BS2 in order to maximise and combine their expertise to bid for large steel contracts in London and across the UK.

Speaking at the recent London launch of the joint venture, David Sands, Chairman of Bourne Steel said: "I am delighted to announce the launch of BS2. Bourne and Billington have complementary skills and a good geographical fit. It made very good sense to bring the two companies together in this joint venture. With our combined skills BS2 will bid for all major, national projects and give clients a new choice."

BS2's Non-Executive Chairman Tom Goldberg said the launch of BS2 marked a fresh chapter within the industry. "I fully expect BS2 to play a pivotal role for years to come with a particular focus on high-rise towers within the capital. I am delighted to be Non-Executive Chairman of such an exciting venture between these two well established companies."

The board of BS2: Left to right, Steve Fareham, Billington Structures Managing Director; Tom Goldberg and David Sands, Bourne Steel Chairman

New automatic marking machine is a standalone unit

Peddinghaus has launched the PeddiWriter, a standalone layout machine able to produce all layout on a structural steel section in a single pass.

The company said the PeddiWriter features state-of-the-art roller probe surface detection, which allocates a proper standoff distance between the material and the plasma torch during a marking programme.

Equipped with the Peddinghaus roller measurement technology, the PeddiWriter guides material through the machine with a powerful drive roller mechanism. A precision encoder tracks the travel of material. This proven method of measurement is said to allow benefits such as streamlined handling, and modular shop layout options.

Lifting bridge floated into position

Working on behalf of main contractor Hochtief UK, Cleveland Bridge positions the first of five spans for the Poole Harbour Second Crossing using mobile jacks and a barge.

During July three spans were floated into position, including the mid-span section which features two hydraulically operated lifting segments. Normally the joint between lifting sections is transverse, but on this bridge they are skewed across the deck creating two triangular shapes, which when raised are said to mirror yachts. Because of this the structure has been dubbed the 'Twin Sails' bridge.

Ben Binden, Cleveland Bridge Project Manager said: "To keep the busy Holes Bay entrance open to boats, we will erect the final two spans, using the same jacking and barge method, during October."

This hiatus allows the main contractor to complete the decks of the positioned spans and also install and commission the hydraulics for the lifting segments. Once installed and ready, boats will be able to enter the Bay via the new mid-span lifting section, while the remainder of the bridge, spans four and five, are completed.

Places available for industry fire seminars

A number of places are still available for two free of charge fire engineering seminars to be held this month in London and Leeds.

Organised by the BCSA and Tata Steel, the half-day morning seminars will bring together a number of fire engineering specialists, to raise industry awareness of their work and to discuss some recent projects.

Leading fire engineering practitioners from the UK will share knowledge and present case studies. The Association for Specialist Fire Protection, will outline its work in maintaining standards and supporting specifiers within the construction sector. Presentations by expert speakers from the Building Research Establishment (BRE) and the BCSA will help raise awareness on the most recent developments in the most cost-effective methods for designing buildings for fire.

The seminars will be held at the Thorpe Park Hotel, Leeds on 14 September, and at the Wellcome Collection Conference Centre, 183 Euston Road, London on 21 September. Registration for both events commences at 8:45am and the seminars conclude with lunch.

To register or for more information contact: *events@steelconstruction.org*

Specifications updated and developed by BCSA

The BCSA has developed a *'Model Specification for the Purchase of Structural Steel Sections, Plates and Bars'* while the BCSA Working Group for Fasteners has updated its *'Model Specification for the Purchase of Structural Bolting Assemblies and Holding Down Bolts'*.

Based on the technical specification given in the *National Structural Steelwork Specification (5th Edition, CE Marking)* the new specification for steel sections, plates and bars has been developed in consultation with the Process and Technical Committee, the Bridgework Conference, steel manufacturers and steel stockholders.

The new specification introduces a number of quality management requirements for manufacturers who supply sections directly and for suppliers who are not the original manufacturer.

Meanwhile, the revised specification for the purchase of structural bolting assemblies and holding down bolts for constructional steelwork should be used in conjunction with the *National Structural Steelwork Specification for Buildings (5th edition, CE Marking)* and the *Steel Bridge Group: Model Project Specification for the Execution of Steelwork in Bridge Structures.*

The updated specification requires non-preloadable bolts to be CE Marked to BS EN 15048-1 and pre-loadable bolts to be CE Marked to BS EN 14399-1. Proprietary fasteners should either be CE Marked in accordance with the relevant European Technical Approval or treated as special fasteners in accordance with BS EN 1090-2.

A modification has been made to Clause 8.1 *'National Highways Sector Scheme 3'* in order to make it clear that a quality management system is required, as well as to encourage bolt manufacturers and distributors to adopt National Highways Sector Scheme 3 for all structures.

Copies of the specifications can be downloaded from *www.steelconstruction.org*

NEWS IN BRIEF

Structural engineering software developer, **CSC**, has released the latest update of its structural calculation software, Tedds. Along with a range of new features and enhancements, the update provides compatibility with Word 2010, benefiting structural engineers across the globe. The latest update is available across all of the global Tedds libraries, including calculations for British Standards, Eurocodes and US and Australian codes. All supported Tedds users will automatically receive this update as part of their maintenance contract. To find out more visit *www.cscworld.com.*

Metsec has launched the first of a series of web-based seminars aimed at providing specifiers with essential support in fulfilling their Continuing Professional Development (CPD) requirements. The seminars cover lattice beams and provide information on their manufacture, specification and use in a variety of building situations. They are presented in a clear, logical sequence, allowing participants to study the course information at their own pace by providing navigation which facilitates pause, rewind and forward functions. Once study of the seminar material is complete, the student undertakes a multiple choice question and answer session, the successful completion of which results in the attainment of a personalised CPD certificate delivered to the student by email.

Two high profile steel construction projects - Royal Shakespeare Theatre, Stratford-upon-Avon and the 2012 Olympic Velodrome - have made it on to the **RIBA Stirling Prize** shortlist for 2011. The winner of this year's prize will be announced on 1 October. Meanwhile, London's Velodrome has also been shortlisted for the 2011 **Structural Awards**, along with Dublin Airport Terminal Two. Organised by the Institution of Structural Engineers, the winner will be announced on 18 November.

Barrett Steel said it has increased capacity and reduced lead times at its Rotherham facility by investing in an upgrade to cutting operations with the installation of a FICEP Tipo A31 automatic CNC drilling and thermal cutting line.

Big Yellow steelwork on show

Rising up alongside one of the country's busiest motorways, steelwork for the Big Yellow Self Storage facility is nearing completion.

Located next to the elevated section of the M4 in Chiswick, west London, approximately 630t of structural steelwork will be erected by Caunton Engineering for the project.

The structure will feature six levels of storage space, constructed above a covered service yard. Three 23m-long trusses, located at roof level, span the building and allow for large open plan floor areas as well as a column free ground floor service area.

Each of the trusses weighs 20t and were brought to site as fully assembled sections. They are supported by large 25m-high 914 columns, each weighing 10t.

Architecturally, the storage facility features a barrel vaulted roof and two cantilevering wing elevations. Two Vierendeel framework trusses, located on both sides of the structure, support the cantilevers and form the sloping facade.

Main contractor for the project is McLaren Construction and the facility is due to open early next year.

Revamp takes shape at Preston academy

The £25M redevelopment of the Fulwood Academy in Preston, Lancashire is nearing completion, with all structural steelwork erection having been completed.

The AA Group (TAAG) has fabricated and erected approximately 475t of steel for the new school building which is due to open next year.

Many of the school's functions are currently being undertaken in temporary buildings as the construction programme takes place. Replacing a demolished arts centre, the new building consists of a large central atrium area with five wings radiating out from it.

Initially TAAG erected the central atrium, supporting it with a temporary structure for stability until all of the perimeter trusses and columns had been installed. Four of the steel framed wings are single storey structures, with the fifth having two-storeys.

Stockholder installs new plasma cutting machine

Parker Steel has purchased and installed one of the latest Gemini 25 plasma cutting and machining systems from FICEP.

The Gemini 25 is a compact footprint automatic CNC machine that is said to require up to 30% less floorspace than other systems and can produce flat metal parts from plate, 6mm up to 80mm thick with cutting lengths from 5m to 30m in one set-up.

Guy Parker Managing director at Parker Steel commented: "The Gemini has enabled Parker's to offer our varied customer base a complete range of services on sheet and plate products with just one phone call. This machine is unbelievably fast in both drilling holes up to 32mm diameter and milling the larger holes and slotted holes equally as fast; add the ability to plasma cut up to 40mm thick and it really is the machine we have been waiting for. The Gemini enables us to pass these savings on to our customers thereby lowering their fabrication costs."

Diary

For all SCI events contact Jane Burrell, tel: 01344 636500 email: *education@steel-sci.com*
For BCSA Events: To reserve your place e-mail your contact details to *events@steelconstruction.org* quoting your preferred venue e.g. 'London'. For queries, please contact the event team on 0207 747 8131.

13 & 19 September 2011
Multi Material Eurocode course – online
A 1 Day course delivered in 2 x half day sessions

14 September 2011
Fire Engineering Seminar
Thorpe Park Hotel
1150 Century Way, Thorpe Park, Leeds LS15 8ZB
Free half-day morning seminar

20 September 2011
Portal Frame Design
Manchester

21 September 2011
Fire Engineering Seminar
Wellcome Collection Conference Centre
183 Euston Road, London NW1 2BE
Free half-day morning seminar

21 & 22 September 2011
Essential Steelwork Design
Birmingham

29 September 2011
Steel Building Design to EC3
Cambridge

Student Awards

An aquatics centre containing multiple pools and an ice rink or single carriageway road bridge across a river were this year's competition requirements.

The 2011 Tata Steel/BCSA Student Awards, organised by the Steel Construction Institute and supported by the Institution of Structural Engineers and the Institution of Civil Engineers, once again revealed the depth of emerging engineering talent in the UK.

The awards which were created 23 years ago to acknowledge excellence in steel design among undergraduates, encourages innovative structural engineering design skills.

Entrants are expected to demonstrate individuality and flair, in addition to showing an understanding of structural design; and to communicate their ideas in a written report with calculations and drawings.

The competition is divided into two steel categories - Structures and Bridges. The Structures category required students to prepare an outline design for a structure to enclose an aquatics centre. This building included an Olympic sized pool, a diving pool, a leisure pool, an ice rink and an upper floor with a viewing gallery and a cafe.

The major aquatics centre was to be constructed in a UK regional city, on a brownfield site, with no limitations on its overall footprint. The site is level, with no constraints on storage during the construction programme.

The Structures first prize went to the University of Sheffield, whose entry was described by the judges as well presented with a very clear artist's impression. The scheme struck a good balance between practicality and ambition, and was very professionally executed.

Second place in the Structures category went to the University of Manchester, with Queens University Belfast collecting the third prize.

The Bridges category was won by the University of Bristol, with the judges panel, chaired by Barry Mawson of Capita Symonds, commenting that the multi-arched open spandrel structure suited the site well.

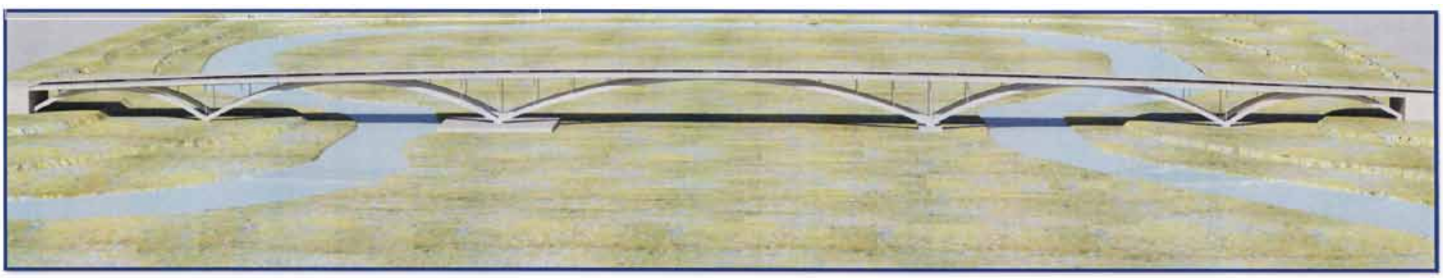
The judges also said the entry was well presented and clearly discussed alternatives. The calculations were also well presented and were accompanied by a good construction programme and cost estimate.

Second place in the Bridges category went to the University of Southampton with the University of Liverpool collecting the third prize.

The Bridges category required students to design a single carriageway structure across a loop in a river. On the outside of the loop, there are cliffs and woodlands, while inside the loop the land is a Site of Special Scientific Interest and consequently there is limited access for construction.

Above: The winning team from the University of Sheffield and their design for an aquatic centre (top)

Below: Bridges category winners from the University of Bristol, and their multi arched bridge design



Excellence achieved at sports centre

Lancaster University, an establishment renowned for its sporting ties, has a new state-of-the-art steel framed sports centre, now open to staff, students, schools and the local community. NSC reports.

FACT FILE
Lancaster University Sports Centre
Main client: Lancaster University
Architect: Faulkner-Browns Architects
Main contractor: Galliford Try
Structural engineer: SKM Anthony Hunt/WYG
Steelwork contractor: The AA Group (TAAG)
Steel tonnage: 420t

Forming part of a £350M investment programme, a new £17.5M sports centre has opened at Lancaster University; a multi-purpose facility which has made significant use of structural steelwork for its large open plan halls as well as achieving a BREEAM 'Excellent' rating.

Constructed on a brownfield site overlooking playing fields within the University's grounds, the sports centre replaces a much older facility dating back to the 1960s.

The rectangular steel framed structure which measures 85m × 60m, utilises a second floor in places. It is sub-divided into two main volumes - the pool, climbing wall, fitness rooms and sauna/steam room, and the sports hall and squash courts area.

"Steel was chosen for the design primarily because of the clear open spans we needed in the pool hall and sports hall," explains FaulknerBrowns' Project Architect Rob Summerson. "However, cost efficiencies also played a part in the decision as well as the fact that steelwork, primarily in the pool area, could be left exposed as an architectural feature."

The pool hall takes up the front third of the overall building, with the Centre's main entrance foyer alongside. The pool structure has been constructed with RHS sections for columns and beams, creating a large 18m-high goal post formation.

"The RHS members were brought to site in sections and then butt welded," explains Kevin Nickson, TAAG Project Manager. "The horizontal part of the frame required one 22.5m-long section."

As well as the exposed steelwork in the pool area, the RHS structural frame has enabled the entrance foyer to have a fully glazed partition wall separating it from the swimming zone.

"This is another architectural feature," explains Mr Summerson. "People entering the Centre are treated to views into the swimming pool, while the glazing also opens up the foyer giving it an airy feel."

The Centre's entrance foyer also looks onto a 10m-high climbing wall.

Beyond the pool, the two-storey segment of the building is heavily braced between bays, as this was deemed the best place to locate cross bracing. Lacking any sizeable lift or stair cores, this bracing gives the structure most of its overall stability.

The sports hall which also occupies approximately one third of the structure's footprint has been formed by one large 1.5m deep truss which spans 38m across the hall, with a series of cellular beams, supported from this member, spanning 35m in the opposite direction.

The truss was brought to site from TAAG's Skelmersdale yard in halves, welded on the ground and then lifted into place in one piece. Likewise, the cellular beams were too large to transport as complete sections, and again were assembled on site.

Main contractor for the project, Galliford Try, says flexibility also played a key role in the decision to use steel. Many of the changing rooms and offices have been built around a standard grid pattern, but these partitions could be removed in the future allowing some of the internal layout to be altered. This possible procedure would be extremely difficult if concrete walls had been constructed.

As Kim Montgomery, Lancaster University Head of Sport, says: " The open airy spaces and architectural design of the Sports Centre makes it not only a pleasure to be in but lifts the performance of our athletes – we envisage it will be a popular destination for National sporting bodies, and teams too."

Feature bracing has been inserted around the structure's perimeter

The Sports Centre overlooks the university's playing fields

An array of facilities

As well as a 25m long eight lane swimming pool the Sports Centre contains a sports hall designed to accommodate numerous sports such as badminton, netball, basketball, 5-a-side football and many other sports. The Centre contains a 10m-high climbing wall, while in an adjoining area there is a 100 station two-level gym and four glass-backed squash courts on level two. The centre also incorporates a health and fitness suite with a sauna and steam room.

Kim Montgomery, Head of Sport, said: "The completion of this building marks a new dawn for sport at Lancaster. Our elite performers have state-of-the-art facilities to train and develop while recreational users can also reap the benefits."

Many of the changing rooms and offices have been built around a standard grid pattern, but these partitions could be removed in the future allowing some of the internal layout to be altered.

A mixture of cladding systems gives the Centre a unique appearance

One large 1.5m deep truss spans the sports hall

A braced two-storey section sits at the centre of the structure

Brought to site piece-small, the trusses were assembled on site and then lifted into place. This was then followed by a similar procedure whereby the curved tendons were attached

Feature trusses form sporting mecca

Steelwork has played an integral role in the construction of one of the most important venues to be used during the 2014 Glasgow Commonwealth Games.

FACT FILE
National Indoor Sports Arena and Velodrome, Glasgow
Main client: Glasgow City Council
Architect: 3D Reid
Main contractor: Sir Robert McAlpine
Structural engineer: Halcrow Yolles
Steelwork contractor: Watson Steel Structures
Steel tonnage: 3,250t

The Commonwealth Games are coming to Glasgow in 2014, and in preparation for this momentous event a number of projects are underway including the construction of the National Indoor Sports Arena (NISA) and Sir Chris Hoy Velodrome.

The venue will host two events - badminton and cycling - at the Games, and will on completion be one of the biggest indoor sports facilities of its type in Europe.

Located on a 10.5 hectare site in the east end of Glasgow, adjacent to Celtic Park and the soon to be built Commonwealth Games Athletes' Village, the venue will act as a catalyst for regeneration and growth in this part of Scotland's largest city.

The indoor arena (with a footprint of 92.4m × 110.7m) will host Badminton events during the Games, and will have 5,000 spectator seats when set-up for sporting competitions. Ordinarily the venue will be used for indoor athletics, as it will include a 200m six lane track, warm-up facilities and areas for field events. Adjoining the arena there is a sports hall annex, housing basketball courts, and this measures 35m × 92m.

How the completed venue will look

The velodrome (90.2m ×116.4m) has been designed by Ralph Schuermann, designer of the Beijing Olympics velodrome. There will be a permanent capacity for 2,000 seated and 500 standing spectators viewing the 250m cycle track, which can be increased to 4,000 seats during the Games.

Essentially the facility is split into two halves, with the steel frames of the velodrome and indoor sports arena both structurally independent and linked together by a concrete framed hub. This is a four storey element which contains among other things the main entrance area and circulation routes, changing rooms, offices and a cafe. On top of the hub their is a two storey plant area (see box story).

Steelwork for the project has been undertaken by Watson Steel Structures, and it has fabricated and erected 3,250t of steel to form primary frameworks for the two structures.

"In addition to this permanent steelwork a further 90t of enabling steelwork has been designed, fabricated and installed to support and stabilise the structures during their partial stages of completion," explains Watson Steel Project Manager Peter Riley.

Watson Steel initially received drawings of the main frame steelwork from Sir Robert McAlpine in April 2010 and then undertook to have the first 1,450t of painted steelwork for the arena delivered to site 18 weeks later in early August. This was followed quickly, at the end of the month, by the first 1,550t of steel for the velodrome, and then finally the 250t of steel for the annex arrived on site in November.

Both main structures are alike in form, with a large column free space at the centre, so consequently they had similar erection programmes. As the hub was one of the first phases of the project to be built, it

The venue will act as a catalyst for the regeneration of this part of Glasgow

offered some stability to the steelwork as it was erected, however temporary works and some ingenious engineering were still required to erect both structures.

The most interesting element of the steelwork, and one that provides the principal strength of both roof structures, are two pairs of unusual primary trusses. Each is formed from a 10m wide × 3.4m deep × 93m long fully braced box girder, manufactured from conventional I-sections.

However, these trusses which will be left exposed - as will all of the roof steelwork within the two arenas - have an added aesthetic element, a pair of underslung curved tension tendons, which further contribute to the strength of the truss, and form a compound girder which is 9.4m deep at its mid-span.

Designing a truss of this size is one thing, bringing it to site is quite another matter. Watson had to identify a strategy which enabled each of the primary trusses, with their curved tendons, to be delivered to site in transportable lengths and then quickly assembled and erected such that they were self supporting over the entire 93m span.

In order to achieve this Watson developed a bespoke bolted connection at the four intersections of the curved tendons. It was designed to resist the tensions in the curvature of the tendons after initial installation, and also to provide access to fully weld the connections at these intersections after installation.

Each of the curved tendons were delivered to site in eight sections, carefully assembled in to their finished shape on a set of containers and temporary frames, and then fully welded into full length 77m-long sections. The four main box girders were meanwhile assembled on site from a number of pieces and formed into two halves while supported on stillages.

Once assembly and initial welding of the curved tendons was completed the two box girder halves were lifted up jointed at mid-span. This was achieved by using two 400t capacity crawler cranes, each rigged with 120t of superlift. The curved tendons were then attached to the underside of the box girders via bespoke temporary connections, fully bolted and diagonal spacer bracings installed.

On completion, each of the trusses was lifted into its final position and released from the cranes, after which the process of fully welding the four remaining tendon connections was completed.

In both the Arena and Velodrome the two primary trusses and their supporting columns, which are located at third points within the structures, were the first roof steelwork sections to be erected. Once up they allowed the secondary trusses, which span in the opposite direction, to be installed along with the remainder of the main frame.

Construction work is expected to be completed on the project by early next year and the complex will open towards the end of 2012.

Galvanizing and colour brought to site

Sitting atop the facility's central hub is a two-level rooftop plant area, and as this 120t steel framework is exposed to the elements, Highland Galvanizers & Colour Coaters were contracted to galvanize this part of the project.

Paul McCafferty, Sales Director of Highland, said: "The Velodrome will be an iconic structure in Glasgow and it's tremendously gratifying to be involved in such a high profile project."

The rooftop is not the only area Highland has been involved with, as the company also specialises in colour coating and consequently it will be bringing zest to the complex. The company will be colour coating all of the external steel bollards and cycle racks after being appointed by project landscape architects Scott Wilson.

The bespoke trusses provide the strength for both of the venue's roof structures

The Inclusion Unit, a special needs teaching pod, sits above the auditorium

Heart of glass and steel

A bespoke steel and glass atrium forms the central hub of a recently completed school in Harlow. NSC reports.

FACT FILE
Passmores School and Technology College, Harlow, Essex
Main client: Essex County Council
Architect: Jestico + Whiles
Main contractor: Willmott Dixon
Structural engineer: AECOM
Steelwork contractor: Adey Steel
Steel tonnage: 65t
Project value: £23M

This month the new Passmores School and Technology College in Harlow opened its doors to students and teachers alike. The school has relocated across town to a new site, a plot which has enabled a project team, led by design and build contractor Willmott Dixon, to create a spacious and architecturally driven structure which has achieved a BREEAM 'Very Good' rating.

The context of Harlow, and of landscaped driven town planning, has strongly influenced the school's sustainable and low impact concept. The overall structural design features five wings that radiate outwards (finger-like) from a central atrium or meeting point. The area provides a natural heart for the school and circulation routes from all of the wings lead into the zone.

This Essex County Council school will accommodate 1,200 students in what is primarily a two-storey radial design. The exceptions being one wing that features a sports hall and the atrium that houses, within its large double-height space, an auditorium with a specialist teaching level above.

Overall the school features a hybrid design as the two-storey wing elements are concrete framed structures, except the sports hall which is timber framed. A third framing material - structural steelwork - has also played an integral role, namely in forming the school's atrium.

The atrium is essentially an elliptically-shaped void, 16m at its widest, at the centre of the overall concrete structure. Within this void an elliptically-shaped auditorium sits at its heart, thus forming an ellipse within an ellipse. Above the auditorium there is a central special needs teaching pod, known as the Inclusion Unit. The roof of the void is spanned with a steel structure which is predominantly glazed, forming a feature element at the project's heart.

The teaching unit has been deliberately placed above the auditorium and at the heart of the school in order to promote inclusiveness for pupils whose classrooms are in many other schools peripherally located.

"Overall the project has a hybrid design and the use of steelwork for the atrium was primarily driven by the long spans we wanted to have," explains Michael Wright, AECOM Regional Director. "We

Box sections form the outer elliptical roof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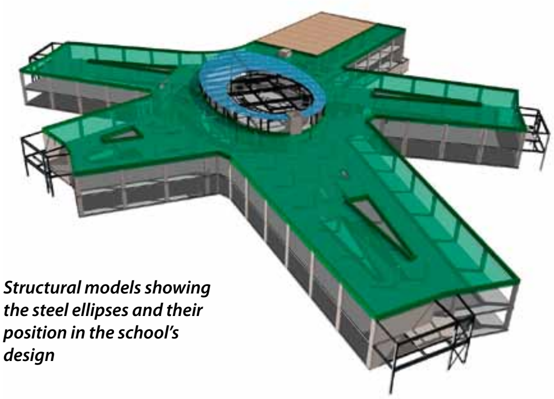
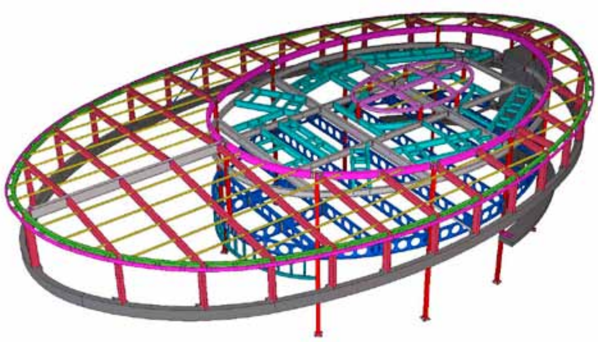
Architecturally inspired

Other steelwork elements of the project include external steel staircases situated at the end of four of the wings and two walkways positioned around part of the double height open plan atrium.

With moveable partition walls at one end, it is envisaged that auditorium performances could break-out from the internal space and allow bigger audiences to attend by using the surrounding area, with the steel walkways then acting as balconies.

The school's entrance also features a steel canopy (left) which is 8.5m long and 3.5m at its widest. Suspended from Macalloy rods, the steel and glazed canopy was delivered to site in one 2t piece, and according to Neil Smith of Adey Steel, it was the largest steel element delivered to site.





Structural models showing the steel ellipses and their position in the school's design

then decided on using cellular beams for the central portion as these would accommodate the services and form the spans economically."

The auditorium is formed by a series of Westok cellular beams supported on eight columns arranged in an elliptical pattern. The upper perimeter of this ellipse is formed by a series of curved cellular members, bent to the correct radii prior to being delivered to site.

Beyond this inner Westok box the outer ellipse roof is formed by a series of box sections radiating out from the inner cellular beams and connecting to a concrete ring beam that forms the perimeter to the surrounding concrete structure.

> *"Getting the geometry correct was especially challenging as it's not just elliptically shaped, the roof also pitches by five degrees."*

A series of stub columns connected to the concrete ring beam and the upper extensions of the inner cellular columns, support the overall elliptically shaped roof.

English Architectural Glazing (EAG) were the subcontractor for the elliptical roof's glazing, and in turn it contracted Adey Steel to undertake the steelwork fabrication and erection.

Designing the roof was very challenging, according to Neil Smith, Operations Director of Adey Steel. "Getting the geometry correct was especially challenging as it's not just elliptically shaped, the roof also pitches by five degrees. It was essential to get the fabrication accurate to ensure we had no problems during the erection programme."

In order to get this complex geometry right Adey Steel limited their design to just one radii per steel member wherever possible. "This made the fabrication process a little easier," adds Mr Smith.

The outer ellipse of roof steelwork supports glazing that wraps around the smaller elliptical roof above the Inclusion Unit classroom. The glazing allows plenty of natural light to penetrate the atrium and circulation areas. Breaking up the glazing, the inner ellipse, which is also the roof above the classroom, is decked and will support a plant area. Within this zone there is a third ellipse which accommodates a feature rooflight above the classroom.

Passmores has been recognised by Ofsted as Outstanding, by the Specialist Schools and Academies Trust as one of the top 100 performing specialist schools in the UK. All of which was achieved in its old accommodation.

Summing up the school's new architecturally driven premises, Headmaster Vic Goddard said: "I am certain that we have created a building that will help us 'improve upon our best' by giving the Harlow community a building that is fit for purpose and most importantly safe and secure."

Light and airy, the glazed roof allows natural light into the school's heart

Sustainability draws on crystalline design

A complex steel framed structure consisting of two interlocking triangular forms with multiple facets will house a centre devoted to showcasing sustainability. Martin Cooper reports from a unique Siemens project in London.

FACT FILE
Siemens Urban Sustainability Centre, London
Main client: Siemens
Architect: Brandon Pringle; Wilkinson Eyre
Main contractor: ISG
Structural engineer: Arup
Steelwork contractor: Rowecord Engineering
Steel tonnage: 800t
Project value: £300M

Siemens has chosen London as the location for its first sustainability centre, a flagship development that will present new technologies and host innovative exhibitions highlighting ways of living and working in a more environmentally friendly manner.

The idea is that interactive events, hosted by Siemens, will be open to the public. The company expects to attract around 100,000 visitors a year, with school groups using the facility for educational trips. The building will be the base for around 230 Siemens employees and provide the potential for around 50 new local jobs.

The ever-expanding Docklands area of London is the chosen location for the Siemens Urban Sustainability Centre, with the project currently rising up on the plot overlooking the Royal Victoria Dock, only a stone's throw from the ExCeL exhibition centre.

Situated in an area where there are already a number of architecturally driven structures, the 7,002m^2 Siemens building will not be easily overlooked or forgotten. The design is unique and based on two interlinked rock crystals bursting forth from the ground. As well as nature, the design draws inspiration from its waterside location and curvature of the nearby O_2 arena.

Within one of the two crystalline shapes there will be a three level corporate zone, housing offices, a 300 seat auditorium, meeting rooms, and a cafe and restaurant. The other crystal form will accommodate an exhibition area, along with a shop, classrooms and plant areas. Both crystals are linked by a main entrance and street area, which will allow access into and between both of the main areas.

Structurally the design creates the internal spaces in each half or crystal with a series of portal frames, using tapering trapezoidal sections fabricated from steel plate sections. Each crystal is independently stable, with the corporate side gaining its stability from portal action in one direction. This part of the steel frame is propped laterally from the first and second floor office slabs and these distribute the horizontal loads via diaphragm action to concrete stair cores.

The exhibition crystal also relies on portal action for stability in one direction, and on the cantilevering action of the superstructure columns in the other.

"The design concept led to the decision to use structural steelwork," says ISG Senior Project Manager Mike Jenner. "To achieve the project's slenderness and get the detailing correct would have been extremely difficult with any other framing material."

"The Siemens centre will be an iconic visitor attraction and educational facility showcasing how sustainability can create better working environments over the next 10-20 years."

Steelwork contractor Rowecord Engineering has erected the structure from south to north, meaning the corporate crystal was completed before work began on the 'street' and then exhibition crystal.

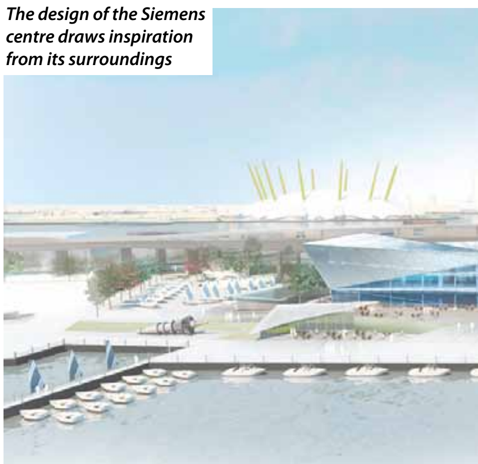
The corporate crystal features two levels of open plan office space, wrapped around a ground floor auditorium. Cellular beams have been used to form all of the floor levels, with Rowecord's own Rowebeam product debuting on the project.

"By using our own design for the cellular beams we were able to fabricate them in our own workshop so that we were in control of fabrication and managed a faster and more commercially competitive outcome." explains Rowecord Contracts Manager Richard Cherrington.

To form the structure's unique crystalline shape, many of the perimeter columns are cranked to follow the line of the glazing mullions. These columns are generally hollow section members, except those which will remain exposed within the completed structure, here the columns are fabricated trapezoidal members.

Chosen for their aesthetic appeal, the large trapezoidal columns were all fabricated from plate and brought to site by Rowecord fully welded. Each of the

The building resembles two crystals bursting from the ground



The design of the Siemens centre draws inspiration from its surroundings

Rowecord's bespoke 'floating' connection

columns is 15m-high and has to absorb considerable loads from the overall structure, consequently they are held in place by large bolted base plates.

Rainwater drainpipes have been secreted within some of the hollow section columns, thus avoiding any unnecessary clutter within the structure. Rowecord had to split the columns in half and insert the stainless steel pipes, and then weld the members back together again.

Another architectural highlight of the steelwork is the bespoke connection between the edge beams and their connecting columns. Giving the impression of a 'floating' connection, an internal tie is welded to the column, while the exterior of the member is left free.

In order to keep a clean and smooth appearance throughout the steel frame, the splice connections between columns and floor beams are hidden within the raised floor zone. The majority of the project's connections are welded and in order to save time most of this has been completed off-site at Rowecord's Newport facility. Where bolted connections have been used, they are also hidden.

"The exception to this has been the roof rafters, some of which are cranked and are much too long to bring to site in fully welded pieces," says Mr Cherrington.

The cranked rafters are needed as each half of the structure has a double pitched

Large trapezoidal columns stand guard as the Siemens centre takes shape

Long cantilevers form the complex roof shape

The completed building will offer views across London's Royal Docks

roof. The roof's longest rafter, connecting the south east corner of the building to the north west, is 72m long. Consequently, this rafter was brought to site in two sections and welded on site, prior to being lifted into place.

As well as a challenging and complex, highly sustainable structural steel frame, the Siemens centre will also boast a host of other sustainability features. The building design will maximise the use of natural daylight, incorporating high performance glazing, photovoltaic panels and energy efficient lighting.


Steel footbridges span the street area


Steelwork wraps around a ground floor auditorium


Using steel was the only way to achieve the structure's slenderness

Rainwater harvesting, ground source heat pumps and solar water heating will also be integral to the design, with the aim to build a facility that reaches the highest standards of sustainability possible.

Chris Brandon, Partner at Pringle Brandon says: "The Siemens centre will be an iconic visitor attraction and educational facility showcasing how sustainability can create better working environments over the next 10-20 years."

Construction of the Siemens Urban Sustainability Centre will be complete by March 2012.

CGI of completed paper mill

The turbine hall, one of the first structures to be completed

Paper mill rolls out steel structures

One of the UK's most advanced recycled paper mills is taking shape on the outskirts of Manchester, a project which is reliant on its many steel framed buildings. Martin Cooper reports.

Steel construction is playing an integral role in the building of a huge recycled paper mill at Partington, on the outskirts of Manchester. Representing a £290M investment by Spanish based Sociedad Anonima Industrias Celulosa Aragonesa (SAICA), the mill, once operational, will produce around 420,000t of 100% recycled containerboard each year.

For the UK's waste paper sector the facility will provide a much needed outlet for used material and a competitive UK-made final product will be available to the companies that use containerboard to package such diverse products as breakfast cereals, pizzas and desktop files.

The mill will house one of the world's fastest board making machines and SAICA's decision to make such a large investment in the UK is based on a number of reasons.

"The UK is short on production of containerboard, but has a stable consumption and good supplies of recovered paper," explains Francisco Carilla, SAICA Director of Industrial Projects.

The project's location also played a key role as Mr Carilla explains: "Partington has good access to motorway networks, there are large volumes of water as we are adjacent to the Manchester Ship Canal and raw materials can be easily sourced."

The project's building programme has been a boon to the UK construction sector during the recession as the majority of firms employed have been local. This includes the steelwork contractors (three in total) who have fabricated, supplied and erected the frames for the paper mill's main structures.

Central to the construction of the mill is the main process building, a structure that will accommodate the paper making equipment. In short, baled recovered paper stored in an adjacent yard will be fed into the building, pulped and then turned into new product with the aid of steam-filled cylinders which dry the paper after its produced.

This process will take place in this large structure measuring 262m in length and 37m at its widest. It is 25m high and consists of two main levels; a ground floor housing hydraulic equipment and a first floor accommodating all of the process equipment.

The steelwork contractor for this large building is Atlas Ward Structures and it has erected 3,700t of structural steel for this one part of the project. The main perimeter columns spaced at 7.5m centres are all bespoke plate girders 1,000mm deep by 500mm wide, chosen because of the large loads they have to absorb. These columns support, at just below roof level, plated crane girders which run along each elevation to allow two 100t capacity overhead cranes to operate.

"Above the crane girder splices we were able to reduce the column sizes to 600mm deep rolled sections as there are far less loads being exerted," explains Jim Martindale, Atlas Ward Deputy Managing Director.

Atlas Ward generally delivered the crane plate girders to site in 22.5m lengths, and these members are 1m deep by 600mm wide. All of the girder's top flanges had to be butt welded to the beam web. "All of these welds were fully tested and the girders were engineered on site to a construction tolerance of +/-2mm at the crane girder supports, using a series of jacking and locking bolts," says Mr Martindale.

When operational the processing equipment will also exert considerable loads and large floor beams support precast planks to form the first floor level. Running the length of one elevation, the building also incorporates a high level mezzanine floor which houses ventilation equipment, while the building's front elevation has attached four-storey office pods and a workshop.

It is estimated the mill will produce in the region of 200 miles of 7.5m wide paper every 3.5 hours.

Because of the high humidity levels the building will experience, there are no cold formed members in this building. Consequently, even the purlins are hot rolled members.

Linked to the process building via a bridge is a large portal framed warehouse, built and designed by Elland Steel Structures. Here the reels of newly produced paper will be held ahead of dispatch to customers.

"The warehouse is a prop portal framed structure, L-shaped to fit into the tight footprint," says Jeremy Shorrocks, Elland Steel Commercial Director.

Covering an area of some 9,200m², the

Bespoke plate girders form the large process building

External works continue as the plant's main warehouse nears completion

main part of the 165m-long warehouse features 44.5m spans, as a large open plan area is required for the huge amount of paper which will be temporarily stored in the building. It has been estimated the mill will produce in the region of 200 miles of 7.5m wide paper every 3.5 hours. A smaller lean-to section of the warehouse is 75m long and features smaller spans of 25m.

This is not the only part of the project undertaken by Elland Steel, as the company has also constructed two other portal crane structures, one a turbine hall/auxiliary building for the site's electricity power plant, and the other a dewatering facility.

The turbine hall is a 'beefed up' portal frame, using slightly larger member sizes than normal as it supports a large internal overhead crane. The 16m high building has two floors and also incorporates an attached two-level electrical annex.

Paper manufacturing by its very nature causes a very harsh and moist atmosphere in the processing areas. This meant Elland had to take special care when applying paint to the steelwork destined for the dewatering plant.

"Because of the humid environment, in some areas of this building we had to apply paint to a thickness of 270 microns, which is triple what we'd normally apply in-house," explains Mr Shorrocks.

Connecting many of the site's structures are an array of pipe bridges carrying all of the facilities utility connections. All of these structures are steel framed as are a number of smaller auxiliary warehouses dotted around the project.

"All of the steelwork contractors working on site have met their deadlines and contributed to the project meeting its overall target of producting its first containerboard early next year," sums up Jan-Olof Strindlund, SAICA Senior Civil Manager.

FACT FILE
SAICA Paper Mill, Partington, Greater Manchester
Main client: SAICA Paper
Project Manager: Christal Management
Structural engineer: POYRY; IDOM
Steelwork contractors: Atlas Ward Structures; Elland Steel Structures
Steel tonnage: 5,300t

The entire project is reliant on numerous steel framed buildings

Member imperfections

David Brown of the SCI offers some observations on the ways member imperfections can be allowed for in member design – by using buckling curves, which allow for a range of second-order effects, including the effect of initial imperfections, or directly within the global analysis.

Introduction

Although building frames are usually analysed assuming that the members are perfectly straight between nodes, no member will achieve this ideal. All design codes allow for the second order effect of ***initial imperfections*** when calculating the design resistance of members. Member imperfections can be accounted for in a number of ways – commonly by using buckling curves, or by accounting for the imperfection directly when calculating the member resistance.

Second order effects

A compression member is shown in Figure 1, with an initial imperfection. When loaded with an axial force, N_{Ed}, the bow will increase. This is a second order effect (commonly known as a P-δ effect, referring to the axial force as P and the deflection as δ), which must be accounted for in the member design. The member experiences stress due to the axial force, but also a bending stress due to the moment. In simple terms, the column buckles when the combination of axial stress and bending stress reaches yield. Note that the bending moment is the product of the axial force and the *final* bow, not the initial bow.

If certain simplifying assumptions are made about the shape of the bow, there is a relationship between the initial imperfection, e_0 and the final imperfection, $\hat{e}$, given by $\hat{e} = e_0 \times \dfrac{1}{\left(1 - \dfrac{N_{ed}}{N_{cr}}\right)}$,

where N_{cr} is the elastic critical force (Euler load), $\left[\dfrac{\pi^2 EI}{L^2}\right]$

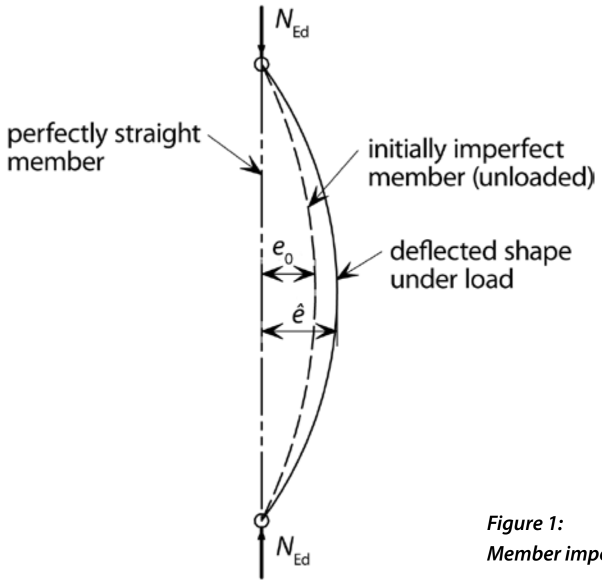


Figure 1: Member imperfections

Buckling curves

Commonly, design standards introduce the concept of a buckling length for unrestrained members. The resistance of a member reduces as the slenderness of the member increases. The relationship is captured as buckling curves, of the form as shown in Figure 2.

Excluding short slendernesses, when the design strength is equal to the yield stress, the design strength is less than yield. The remaining capacity of

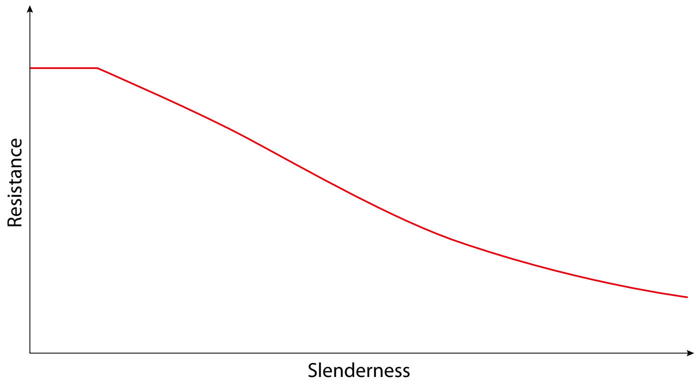


Figure 2: Typical buckling curve

the section is used in resisting the bending, which has come from the axial force multiplied by the imperfection of the member, as shown in Figure 1. The use of buckling curves (manifest as look-up tables in BS 5950 or Equations in BS EN 1993-1-1) means that designers do not have to consider the actual initial imperfections or calculate the P-δ effects due to member imperfections. If the buckling curves are used to calculate the member resistance, the initial imperfection may be back-calculated. The calculated imperfection is larger than the permitted physical tolerance, because the imperfection also allows for such issues as residual stresses.

Initial imperfections in the member design

One alternative to the use of buckling curves is to include member imperfections, and their second order effects, in the calculation of the forces and moments on a member. This has some attractions, because if all imperfections and second order effects have been accounted for, there is no need to calculate a buckling resistance – a cross sectional check will be sufficient. This approach is endorsed in BS EN 1993-1-1 clause 5.2.2(7)a.

The inclusion of imperfections and second order effects is not as daunting as may be imagined. BS EN 1993-1-1 includes a list of initial imperfections in Table 5.1. In the UK, it was felt that these initial imperfections are too onerous, so the UK National Annex advises that the initial imperfection should be back-calculated from the formulae for the buckling curves. This has the advantage that the initial imperfections are less onerous than the core Eurocode, but does mean that the initial imperfection is not a simple ratio of length as given in Table 5.1. The process of back calculation also means that the resistance of a member is always identical, whichever approach is taken – a self-fulfilling prophecy.

Example of back-calculation

Assume a 203 UKC 46 in S355 steel, 6 m length between pinned supports.

The resistance of the section could be calculated using the formulæ in Section 6.3 of BS EN 1993-1-1, but the simpler option is to take the resistance from the Blue Book, which is 1390 kN (in the major axis)

The stress due to the compression alone is therefore

$$\frac{N_{b,Rd}}{\text{Area}} = \frac{1390 \times 10^3}{5870} = 237 \text{ N/mm}^2$$

The remaining stress (355 – 237 = 118) is dealing with the bending. Although there are no externally applied bending moments, bending of the member results from its initial imperfection.

Using elastic section properties, $118 = \dfrac{\text{second order moment}}{\text{elastic modulus}}$

Bending moment = $118 \times 450 \times 10^{-3} = 53.1$ kNm

The moment is the product of the axial force and the final imperfection, $\hat{e}$,

$$\hat{e} = 53.1 \times 10^3 / 1390 = 38.2\text{mm}$$

To calculate the initial imperfection,

$$N_{cr} = \frac{\pi^2 EI}{L^2} = \frac{\pi^2 \times 210 \times 10^3 \times 4570 \times 10^4}{6000^2 \times 10^3} = 2630 \text{ kN}$$

Because $\hat{e} = e_0 \times \dfrac{1}{\left(1 - \dfrac{N_{ed}}{N_{cr}}\right)}$, then $38.2 = e_0 \times \dfrac{1}{\left(1 - \dfrac{1390}{2630}\right)}$,

and thus $e_0 = 18$ mm
From Table 6.2 of BS EN 1993-1-1, the curve for major axis buckling of a UKC section is curve *b*. Table 5.1 gives the initial imperfection as *L*/250 or 24mm, demonstrating the UK view that the initial imperfection in the Eurocode Table is conservative.

An alternative way to calculate the initial imperfection e_0 is to use the expression $e_0 = \alpha\,(\bar{\lambda} - 0.2)\,\dfrac{W}{A}$, where $\bar{\lambda}$ is the non-dimensional slenderness given by $\bar{\lambda} = \sqrt{\dfrac{Af_y}{N_{cr}}}$ and α is the appropriate imperfection factor from Table 6.1

In this case, $\bar{\lambda} = \sqrt{\dfrac{Af_y}{N_{cr}}} = \sqrt{\dfrac{5870 \times 355}{2631 \times 10^3}} = 0.89$

The imperfection factor for buckling curve b is 0.34 from Table 6.1.

Therefore, $e_0 = 0.34\,(0.89 - 0.2)\,\dfrac{450 \times 10^3}{5870} = 18$ mm

Initial imperfections in the global analysis

BS EN 1993-1-1 also suggests that the initial imperfections can be allowed for in analysis, by using an equivalent set of loads on the member. Figure 3 shows the relationship between the initial imperfection and the equivalent loads.

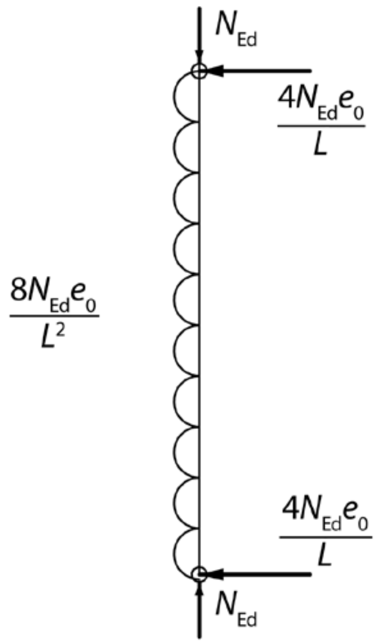


Figure 3: Equivalent imperfection forces

Of course, using the initial imperfection will not account for the second order effects, so it is convenient to base the equivalent set of loads on the final imperfection, $\hat{e}$.

In the earlier example, $e_0 = 18$ mm and $\hat{e} = 38.2$ mm

The equivalent UDL is $\dfrac{8N_{Ed}\hat{e}}{L^2} = \dfrac{8 \times 1390 \times 38.2 \times 10^{-3}}{6^2} = 11.8$ kN/m

The midspan bending moment due to this loading =

$\dfrac{11.8 \times 6^2}{8} = 53.1$ kN/m

Because the member imperfections and second order effects have been accounted for already, only a cross sectional check under the combination of axial force and moment is needed.

Thus

$\dfrac{\text{Axial force}}{\text{Area}} + \dfrac{\text{Bending moment}}{\text{Modulus}} = \dfrac{1390 \times 10^3}{5870} + \dfrac{53.1 \times 10^6}{450 \times 10^3} = 355 \text{ N/mm}^2$

Where may this approach be useful?

The concept of a buckling length (or effective length) has been in use in the UK for many years, so is likely to remain the commonly used approach. However, there are instances when it is not easy or convenient to determine a buckling length, and it may be simpler to determine the initial imperfection, amplify it to allow for *P*-δ effects and then simply check the cross section.

This approach may have advantages in portal frame design to the Eurocode, for example, as a way to side-step the in-plane buckling checks on individual members. UK practice has been to never check the in-plane buckling of rafters or columns carrying typically large moments at the connections, but for in-plane resistance, simply to ensure that the cross sectional resistance was adequate for the applied forces and moments. Part of the justification for this approach was that the additional *P*-δ effects due to member imperfections reach a maximum at mid span or mid height, but at this location the externally applied moments are much smaller. As shown in Figure 4, if the cross section is adequate at the point of the maximum moment, it will also be adequate at the mid point of the member, even though *P*-δ effects are added.

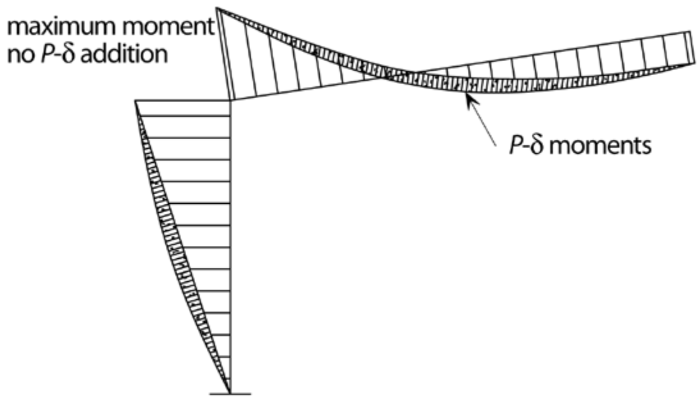


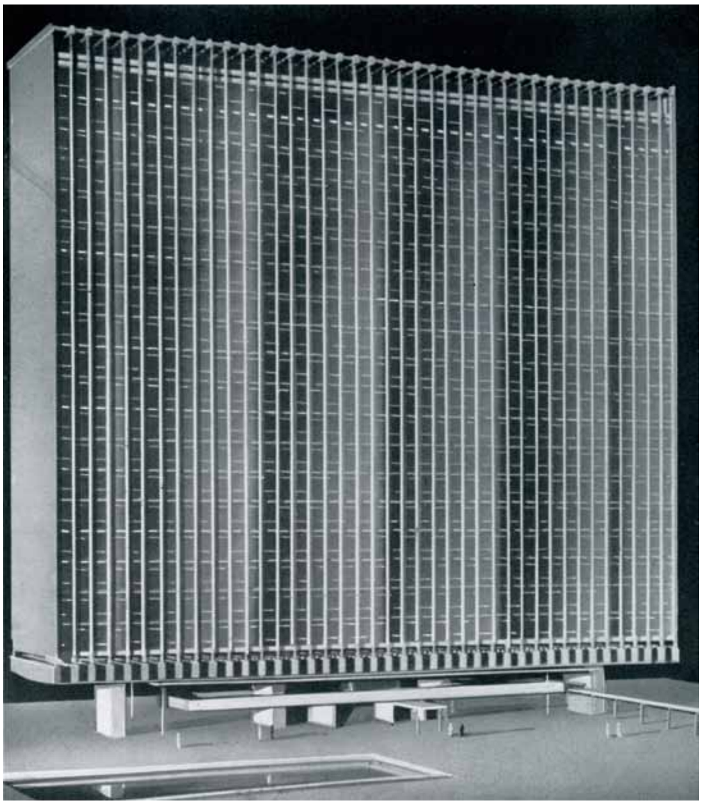
Figure 4 Additional P-δ effects in a portal frame

Note that the preceding comments have only applied to in-plane buckling. *P*-Δ effects (sensitivity of the frame as a whole to the second order effects of frame deflections Δ) must still be considered and allowed for if necessary. Out of plane buckling checks are also still required.

Designers should also note that that this article has focused on *P*-δ effects arising from member imperfections. *P*-δ effects also arise when the externally applied bending moments induce curvature in the member.

Overseas Buildings in Steel

From Building with Steel, August 1961

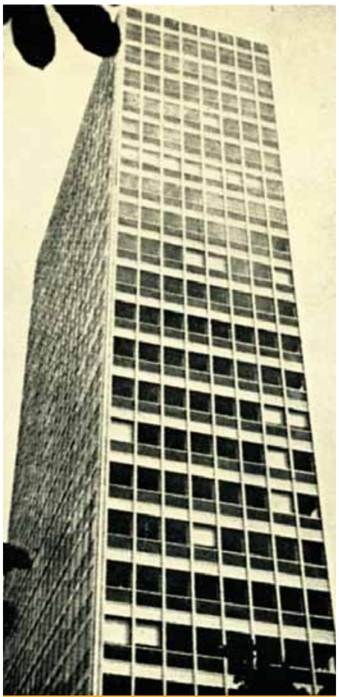


Above: The Palace of Development, Brasilia, designed as the headquarters of Brazilian National Steel Corporation by the world famous architect Oscar Niemeyer.

Left: The new 42-storey headquarters building of the Equitable Life Assurance Society in New York City. Architects: Skidmore Owings and Merrill, New York. Consulting Engineers: Weiskopf and Pickworth.

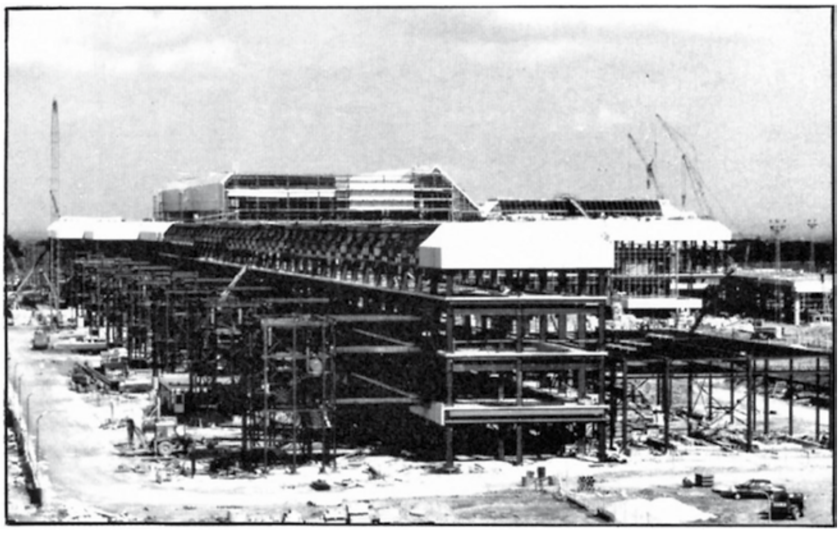
Below Left: New administrative headquarters for the Nestlé Alimentia Co on the shore of Lake Geneva, Switzerland. Architect: Prof J Tschumi SIA, SAF

Below Right: Administrative building of Mannesmann AG in Düsseldorf, West Germany.



Taken from STEEL CONSTRUCTION, August 1991

Manchester Airport Terminal 2



Manchester Airport's Terminal 2 is now halfway through its 40 month construction period. The photograph shows the pier and terminal building from the East, with the stand access towers on the left and the combined heat and power plant taking shape on the right. On the far right is the 17 span elevated roadway. The main mechanical plant room is prominent above the main building and to the right the glazing is proceeding above the concourse area. AMEC Projects are management contractors for phase one of the £520 million Terminal 2 development.

The first phase of Manchester Airport's £570 million development was recently (1991) 'topped out' by Transport Secretary Malcolm Rifkind MP.

The ceremony marked the halfway stage of the construction programme which began in May 1990. The steelwork contract was awarded to William Hare of Bolton and the management contractors, AMEC Projects, are now reporting that final completion remains on schedule.

William Hare also co-ordinated the installation by subcontractors Quikspan of the building composite floor decking. The first phase consisted of the structural steel frame of the terminal which is 140m long x 120m wide and the 612m long attached pier along its face.

The steelwork, consisting of approximately 10,000 tonnes of grade 50 steel in some 17,000 individual pieces, was designed and developed concurrently with the detailing and fabrication and thus required very close co-ordination by AMEC Projects between the structural engineers Scott Wilson Kirkpatrick and the fabricator to minimise delays to the following trades.

The terminal building has two distinct types of roof construction. One configuration comprises lattice girders supporting a conventional three layers felt roof. The lattice girders are fabricated from a rectangular and circular hollow sections. The second is a pre-fabricated space fame system supplied by Space Decks Ltd. The space frame modules will support a roof glazing system to the check-in concourse areas of the building, which has been designed to make the most of natural daylight.

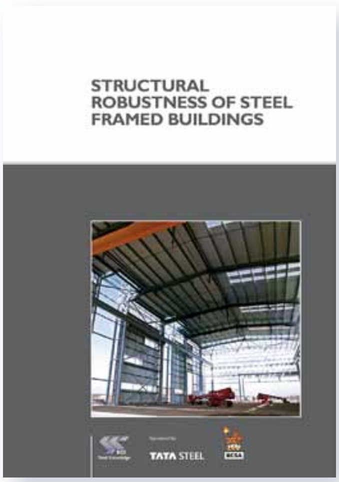
The roof decking to the terminal building is also complete and works are currently progressing to the east and west piers. The erection of precast wall panels, curtain walling, cladding and roof glazing is well advanced, following which the building will be weathertight.

Externally, the 17 span 340 metre long elevated roadway to the departures level is well underway and work has recently begun on the permanent road to the Terminal 2 complex which will progress concurrently with the new M56 motorway bridge and link roads.

Terminal 2 is scheduled for completion in December 1992 and will open to the public in Spring 1993.

Publications

Structural Robustness of Steel Framed Buildings



Structural robustness is an important consideration for the design of buildings so that the likelihood of disproportionate collapse, as a result of accidental actions, is limited.

This publication provides design guidance on the Eurocode strategies for structural robustness and designing for the avoidance of disproportionate collapse, as required by the UK Building Regulations.

Where the Eurocodes do not include specific requirements, this publication offers recommendations for good practice. The publication covers construction in the UK and reference is made to the UK National Annexes as appropriate.

In addition to the design guidance, this publication offers six worked examples which are included to demonstrate the application of robustness strategies to different classes of building.

Full Price £40.00
(BCSA and SCI member price £20.00)

Catalogue number	**P391**
ISBN number	978-1-85942-198-7
Authors	A G J Way MEng CEng MICE
Pagination	126 pp
Pages	A4 Paperback
Publication date	August 2011

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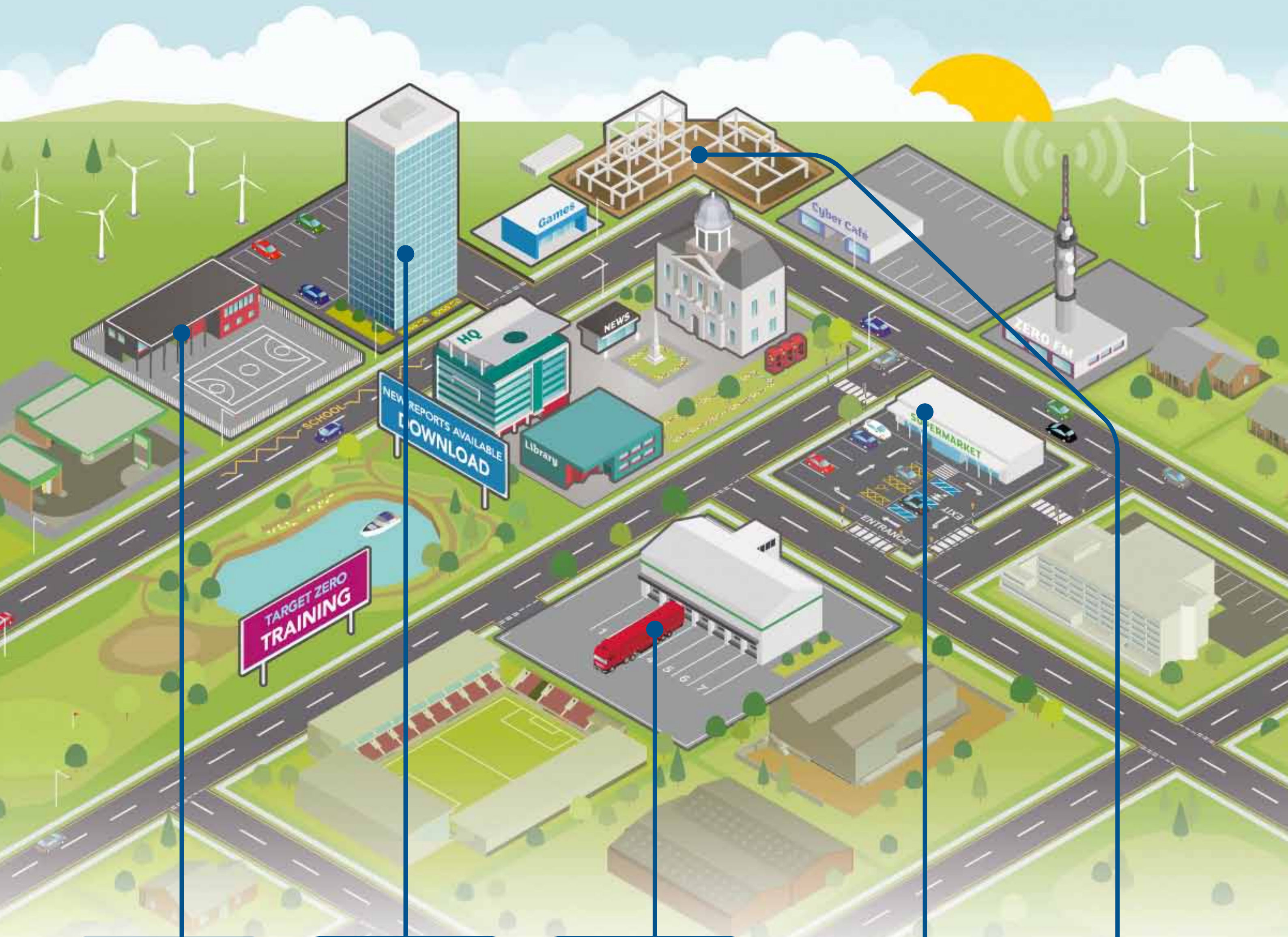
Target Zero is a steel construction sector project designed to provide guidance on the design and construction of sustainable, low and zero carbon buildings. Five non domestic building types are being analysed in the project funded by Tata Steel and the British Constructional Steelwork Association.



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AD 361
Mono pitched portal frames in fire boundary conditions

In SCI publication P313, *Single Storey Steel Framed Buildings in Fire Boundary Conditions*, Section 2.5.4 gives guidance on the calculation of overturning moments for mono pitched frames. However, it has come to SCI's attention that the expressions in that Section can give negative values of overturning moment for certain configurations of mono pitched frames.

The purpose of this AD Note is to provide clarification on the use of Section 2.5.4.

The problem of negative values of overturning moment given by expressions in Section 2.5.4 occurs when the frame being checked has short rafter spans or lightly loaded rafters, as this tends to cause low rafter utilisation. In such cases, the value of the horizontal force associated with the plastic collapse mechanism, H, has a small or even negative value, according to the expression on page 14 of P313. With a negative value of H, the values of OTM_1 and OTM_2 given by the expressions on page 13 can also become negative.

A negative value of H has no physical significance as far as the fire performance of the frame is concerned; it simply means that at the rafter temperature considered (890°C) the frame will not develop a mechanism under the applied loading.

So, as a first step, H should not be taken as less than zero. However, with $H = 0$ and light loading on the rafter, the values of OTM_1 and OTM_2 may be small. Noting that the design model for duo pitched rafters includes a minimum value of overturning moment, it would be prudent to adopt a similar approach for mono pitched frames. The column base should be designed to resist a minimum value of overturning moment equal to 10% of the column moment resistance.

Contact: **W I Simms**
Tel: **01344 636525**
Email: **advisory@steel-sci.com**

New and revised codes & standards

From BSI Updates July & August 2011

BS IMPLEMENTATIONS

BS ISO 20805:2011
Hot-rolled steel sheet in coils of higher yield strength with improved formability and heavy thickness for cold forming.
Supersedes BS ISO 20805:2005

PUBLISHED DOCUMENTS

PD 6694-1:2011
Recommendations for the design of structures subject to traffic loading to BS EN 1997-1:2004
No current standard is superseded

PD ISO/TR 10809-2:2011
Cast irons. Welding
No current standard is superseded

PD 6688-1-1:2011
Recommendations for the design of structures to BS EN 1991-1-1
No current standard is superseded

NEW WORK STARTED

EN 1337-1
Structural bearings. General design rules
Will supersede BS EN 1337-1:2000

DRAFT BRITISH STANDARDS FOR PUBLIC COMMENT

11/30215307 DC
BS ISO 630-3 Structural steels. Technical delivery conditions for fine grain structural steels

11/30215310 DC
BS ISO 630-4 Structural steels. Technical delivery conditions for high yield strength quenched and tempered structural steel plates

11/30227247 DC
BS ISO 7452 Hot rolled steel plates. Tolerances on dimensions and shape

CORRIGENDA TO BRITISH STANDARDS

BS EN 1090-1:2009
Execution of steel structures and aluminium structures. Requirements for conformity assessment of structural components
CORRIGENDUM 1

BRITISH STANDARDS PROPOSED FOR CONFIRMATION

BS 4 -1:2005
Structural steel sections. Specification for hot-rolled sections

BS 5395-2:1984
Stairs, ladders and walkways. Code of practice for the design of helical and spiral stairs

BS 5606:1990
Guide to accuracy in building


Photo by Ian Bramham
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Strength from Advisory Service

Designing and building in steel has never been as straightforward as it is today, and steel still remains the material of choice for construction in the UK. The steel sector provides comprehensive and in-depth technical back up to ensure that those using steel have all the guidance and support they could need at their finger tips.

The co-ordinated and comprehensive support provided by the BCSA's Structural Advisory Serivce is free of charge to specifiers, clients and designers. Technical experts are on hand to provide an extensive range of services, including design assistance on structural form, performance of steel buildings, seminars and in-house CPD presentations, etc.

Richard Dixon, Manager, Structural Advisory Services, who heads up the network of Regional Technical Managers throughout the UK and Ireland said: "We have a team of experienced regional engineers who are on hand to offer design support and advice to designers, and to point them to the wide range of technical guidance and resources available to them and inform them in a practical way on key topics like EC3 and the sustainability of steel construction through in-house CPDs."

Colin Smart **London & the South East**	+44 (0)788 548 3949 Colin.Smart@steelconstruction.org
Dave Chapman **The West & Wales**	+44 (0)773 992 1811 Dave.Chapman@steelconstruction.org
Richard Dixon **The East**	+44 (0)771 536 6392 Richard.Dixon@steelconstruction.org
Walter Swann **The North & Scotland**	+44 (0)773 498 5140 Walter.Swann@steelconstruction.org
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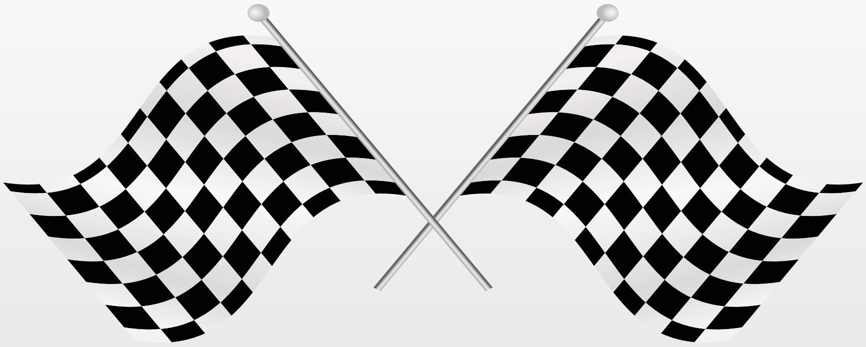
SCI MEMBERS' DAY INVITATION

SCI
Steel Knowledge

Tuesday 27th September 2011



SCI will be holding its annual Members' Day Event at the unique venue of Brooklands Museum, Weybridge, Surrey.

For the first time this event is open to invited non-SCI members giving a greater opportunity to meet with industry colleagues and to find out more about SCI and the value we offer to those involved in the Steel Construction Industry.

The day will focus on innovative design and support.

Presentations will be made by:
SCI, Eurobond and BSI

Timing for the day will be
10:30 - 16:00

(A buffet lunch will be included).

Free access to the Museum is available to all attending. A number of attendees will be given the opportunity to participate in the Concorde Experience; going on-board and experiencing a virtual flight.

BROOKLANDS MUSEUM

Reply to Lis Oliver on 01344 636525
membership@steel-sci.com www.steel-sci.org/courses

Steelwork contractors for buildings

BCSA is the national organisation for the steel construction industry.
Membership of BCSA is open to any Steelwork Contractor who has a fabrication facility within the United Kingdom or Republic of Ireland.
Details of BCSA membership and services can be obtained from
Gillian Mitchell MBE, Deputy Directory General, BCSA, 4 Whitehall Court, London SW1A 2ES
Tel: 020 7839 8566 Email: *gillian.mitchell@steelconstruction.org*

Applicants may be registered in one or more Buildings category to undertake the fabrication and the responsibility for any design and erection of:

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- **E** Large span portals (over 30m)
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- **G** Medium rise buildings (from 5 to 15 storeys)
- **H** Large span trusswork (over 20m)
- **J** Tubular steelwork where tubular construction forms a major part of the structure
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- **L** Architectural steelwork for staircases, balconies, canopies etc
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- **N** Large grandstands and stadia (over 5000 persons)
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- **R** Refurbishment
- **S** Lighter fabrications including fire escapes, ladders and catwalks
- **QM** Quality management certification to ISO 9001
- **SCM** Steel Construction Sustainability Charter (● = Gold, ● = Silver, ● = Member)

Notes

(1) Contracts which are primarily steelwork but which may include associated works. The steelwork contract value for which a company is pre-qualified under the Scheme is intended to give guidance on the size of steelwork contract that can be undertaken; where a project lasts longer than a year, the value is the proportion of the steelwork contract to be undertaken within a 12 month period.

Where an asterisk (*) appears against any company's classification number, this indicates that the assets required for this classification level are those of the parent company.

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	SCM	Contract Value (1)
A C Bacon Engineering Ltd	01953 850611			●	●		●											Up to £2,000,000
ACL Structures Ltd	01258 456051			●	●	●	●				●				●		● (Member)	Up to £2,000,000
Adey Steel Ltd	01509 556677				●	●	●	●		●	●			●	●		● (Member)	Up to £4,000,000
Adstone Construction Ltd	01905 794561			●	●	●												Up to £1,400,000
Advanced Fabrications Poyle Ltd	01753 531116				●		●	●	●	●	●				●	✓		Up to £400,000
Angle Ring Company Ltd	0121 557 7241												●					Up to £1,400,000
Apex Steel Structures Ltd	01268 660828				●		●			●	●							Up to £800,000
Arromax Structures Ltd	01623 747466	●		●	●	●	●	●	●	●	●	●						Up to £800,000
ASA Steel Structures Ltd	01782 566366			●	●	●	●			●	●			●	●			Up to £800,000*
ASD Westok Ltd	01924 264121												●					Up to £6,000,000
ASME Engineering Ltd	020 8966 7150				●					●	●			●	●	✓		Up to £1,400,000*
Atlas Ward Structures Ltd	01944 710421		●	●	●	●	●	●	●	●	●	●		●	●	✓	● (Gold)	Above £6,000,000
Atlasco Constructional Engineers Ltd	01782 564711			●	●	●	●							●				Up to £2,000,000
Austin-Divall Fabrications Ltd	01903 721950			●	●		●	●		●	●			●	●			Up to £800,000
B&B Group Ltd	01942 676770			●	●	●	●	●		●	●	●		●		✓		Up to £1,400,000
B D Structures Ltd	01942 817770			●	●	●	●				●	●		●				Up to £800,000
Ballykine Structural Engineers Ltd	028 9756 2560			●	●	●	●	●				●				✓		Up to £1,400,000
Barnshaw Section Benders Ltd	01902 880848												●			✓	● (Silver)	Up to £800,000
Barrett Steel Buildings Ltd	01274 266800			●	●	●	●									✓	● (Gold)	Up to £6,000,000
Barretts of Aspley Ltd	01525 280136			●	●	●				●	●			●	●	✓		Up to £3,000,000
BHC Ltd	01555 840006	●	●	●	●	●	●							●				Above £6,000,000
Billington Structures Ltd	01226 340666		●	●	●	●	●	●	●	●	●	●		●		✓	● (Gold)	Above £6,000,000
Border Steelwork Structures Ltd	01228 548744			●	●	●	●			●	●				●			Up to £3,000,000
Bourne Construction Engineering Ltd	01202 746666		●	●	●	●	●	●	●	●	●	●	●	●		✓	● (Gold)	Above £6,000,000
Briton Fabricators Ltd	0115 963 2901	●		●	●	●	●	●	●	●	●			●	●	✓		Up to £3,000,000
Cairnhill Structures Ltd	01236 449393	●			●	●	●	●	●	●	●			●	●	✓	● (Gold)	Up to £2,000,000
Caunton Engineering Ltd	01773 531111	●	●	●	●	●	●	●	●	●	●	●		●	●	✓	● (Gold)	Up to £6,000,000
Cleveland Bridge UK Ltd	01325 502277	●	●	●	●	●	●	●	●	●	●	●		●		✓	● (Silver)	Above £6,000,000
CMF Ltd	020 8844 0940				●		●	●		●	●				●			Up to £6,000,000
Cordell Group Ltd	01642 452406	●			●	●	●	●	●	●	●					✓		Up to £3,000,000
Coventry Construction Ltd	024 7646 4484			●	●	●	●		●	●	●			●	●			Up to £1,400,000
D H Structures Ltd	01785 246269				●		●				●			●				Up to £40,000
Discain Project Services Ltd	01604 787276				●					●	●				●	✓		Up to £800,000
Duggan Steel Ltd	00 353 29 70072		●	●	●	●	●	●			●					✓		Up to £6,000,000
Elland Steel Structures Ltd	01422 380262		●	●	●	●	●	●	●	●	●	●		●		✓	● (Silver)	Up to £6,000,000
EvadX Ltd	01745 336413			●	●	●	●	●	●	●	●	●				✓	● (Gold)	Up to £3,000,000
Fisher Engineering Ltd	028 6638 8521		●	●	●	●	●	●	●	●	●	●				✓	● (Gold)	Above £6,000,000
Fox Bros Engineering Ltd	00 353 53 942 1677			●	●	●	●	●			●							Up to £3,000,000
GME Structures Ltd	01939 233023			●	●		●	●		●	●			●	●			Up to £400,000
Gorge Fabrications Ltd	0121 522 5770				●	●	●	●		●				●				Up to £800,000
Graham Wood Structural Ltd	01903 755991		●	●	●	●	●	●	●	●	●	●		●			● (Silver)	Up to £6,000,000
Grays Engineering (Contracts) Ltd	01375 372411				●			●		●	●				●			Up to £100,000
Gregg & Patterson (Engineers) Ltd	028 9061 8131			●	●	●	●	●				●				✓		Up to £3,000,000
H Young Structures Ltd	01953 601881			●	●	●	●	●			●						● (Member)	Up to £2,000,000
Had Fab Ltd	01875 611711								●		●				●	✓		Up to £2,000,000
Hambleton Steel Ltd	01748 810598		●	●	●	●	●	●				●		●		✓	● (Silver)	Up to £6,000,000
Harry Marsh (Engineers) Ltd	0191 510 9797			●	●	●	●				●	●						Up to £2,000,000
Henry Smith (Constructional Engineers) Ltd	01606 592121			●	●	●	●	●										Up to £3,000,000
Hescott Engineering Company Ltd	01324 556610			●	●	●	●			●				●	●			Up to £4,000,000

Company name | Tel | C | D | E | F | G | H | J | K | L | M | N | Q | R | S | QM | SCM | Contract Value (1)

Company name	Tel	C	D	E	F	G	H	J	K	L	M	N	Q	R	S	QM	SCM	Contract Value (1)
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Kiernan Structural Steel Ltd	00 353 43 334 1445			●	●	●	●	●	●	●	●	●		●	●	✓	●	Up to £4,000,000
Leach Structural Steelwork Ltd	01995 640133			●	●	●	●	●			●						●	Up to £1,400,000
M Hasson & Sons Ltd	028 2957 1281			●	●	●	●	●	●	●	●				●	✓		Up to £3,000,000
M&S Engineering Ltd	01461 40111				●				●	●	●			●	●			Up to £1,400,000
Mabey Bridge Ltd	01291 623801	●	●	●	●	●	●	●	●	●	●	●	●	●		✓	●	Above £6,000,000
Mackay Steelwork & Cladding Ltd	01862 843910			●	●		●			●	●			●	●	✓		Up to £800,000
Maldon Marine Ltd	01621 859000				●			●	●	●					●			Up to £1,400,000
Mifflin Construction Ltd	01568 613311		●	●	●	●	●				●							Up to £3,000,000
Newbridge Engineering Ltd	01429 866722			●	●	●	●								●	✓		Up to £1,400,000
Nusteel Structures Ltd	01303 268112						●	●	●	●						✓		Up to £4,000,000
On Site Services (Gravesend) Ltd	01474 321552				●		●	●		●	●				●			Up to £200,000
Overdale Construction Services Ltd	01656 729229			●	●		●	●			●				●			Up to £400,000
Paddy Wall & Sons	00 353 51 420 515			●	●	●	●	●	●	●	●					✓		Up to £6,000,000
Painter Brothers Ltd	01432 374400								●		●				●	✓	●	Up to £6,000,000
Pencro Structural Engineering Ltd	028 9335 2886			●	●		●	●			●				●	✓		Up to £2,000,000
Peter Marshall Steel Stairs Ltd	0113 307 6730									●					●			Above £6,000,000*
PMS Fabrications Ltd	01228 599090			●	●	●	●		●	●	●			●	●			Up to £1,400,000
REIDsteel	01202 483333		●	●	●	●	●	●	●	●	●	●		●				Up to £6,000,000*
Rippin Ltd	01383 518610			●	●	●	●	●										Up to £1,400,000
Robinson Steel Structures	01332 574711		●	●	●	●	●		●	●	●	●		●	●	✓	●	Above £6,000,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✓	●	Above £6,000,000
Rowen Structures Ltd	01773 860086		●	●	●	●	●	●	●	●	●	●		●				Above £6,000,000*
S H Structures Ltd	01977 681931						●	●	●	●						✓	●	Up to £3,000,000
Severfield-Reeve Structures Ltd	01845 577896	●	●	●	●	●	●	●	●	●	●	●	●	●	●	✓	●	Above £6,000,000
Shipley Fabrications Ltd	01400 231115			●	●	●	●		●	●	●				●			Up to £200,000
SIAC Butlers Steel Ltd	00 353 57 862 3305		●	●	●	●	●	●	●		●	●				✓	●	Above £6,000,000
SIAC Tetbury Steel Ltd	01666 502792			●	●	●	●				●	●				✓	●	Up to £3,000,000
Snashall Steel Fabrications Co Ltd	01300 345588			●	●		●								●			Up to £1,400,000
South Durham Structures Ltd	01388 777350			●	●	●				●	●	●			●			Up to £1,400,000
Temple Mill Fabrications Ltd	01623 741720			●	●	●	●				●	●			●			Up to £200,000
The AA Group Ltd	01695 50123			●	●	●	●			●	●	●		●	●		●	Up to £4,000,000
Traditional Structures Ltd	01922 414172		●	●	●	●	●	●	●		●	●		●		✓	●	Up to £4,000,000*
Tubecon	01226 345261						●	●	●	●				●	●	✓		Above £6,000,000*
W & H Steel & Roofing Systems Ltd	00 353 56 444 1855			●	●	●	●	●						●	●			Up to £4,000,000
W I G Engineering Ltd	01869 320515				●					●					●			Up to £200,000
Walter Watson Ltd	028 4377 8711			●	●	●	●	●				●				✓		Up to £6,000,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●	●	●	●	●	●		●	●	✓	●	Above £6,000,000
Westbury Park Engineering Ltd	01373 825500	●			●		●	●	●	●	●				●	✓		Up to £800,000
William Haley Engineering Ltd	01278 760591			●	●	●			●	●	●					✓	●	Up to £2,000,000
William Hare Ltd	0161 609 0000	●	●	●	●	●	●	●	●	●	●	●		●		✓	●	Above £6,000,000

Company name Tel C D E F G H J K L M N Q R S QM SCM Contract Value (1)

Corporate Members

Corporate Members are clients, professional offices, educational establishments etc which support the development of national specifications, quality, fabrication and erection techniques, overall industry efficiency and good practice.

Company name	Tel
Balfour Beatty Utility Solutions Ltd	01332 661491
Griffiths & Armour	0151 236 5656
Highways Agency	08457 504030
Roger Pope Associates	01752 263636
Sandberg LLP	020 7565 7000
SUM	0113 242 7390

Associate Members

Associate Members are those principal companies involved in the direct supply to all or some Members of components, materials or products. Associate member companies must have a registered office within the United Kingdom or Republic of Ireland.

1 Structural components
2 Computer software
3 Design services
4 Steel producers
5 Manufacturing equipment
6 Protective systems
7 Safety systems
8 Steel stockholders
9 Structural fasteners
SCM Steel Construction Sustainability Charter
● = Gold, ● = Silver, ● = Member

Company name	Tel	1	2	3	4	5	6	7	8	9	SCM
AceCad Software Ltd	01332 545800		●								
Albion Sections Ltd	0121 553 1877	●									
Andrews Fasteners Ltd	0113 246 9992									●	
ArcelorMittal Distribution – Birkenhead	0151 647 4221								●		
ArcelorMittal Distribution – Birmingham	0121 561 6800								●		
ArcelorMittal Distribution – Bristol	01454 311442								●		
ArcelorMittal Distribution – Manchester	0161 703 9073								●		
ArcelorMittal Distribution – South Wales	01633 627890								●		
ArcelorMittal Distribution – Scunthorpe	01724 810810								●		
ArcelorMittal Distribution – Wolverhampton	01902 365200								●		
Arro-Cad Ltd	01283 558206			●							
ASD Interpipe UK Ltd	0845 226 7007								●		
ASD metal services - Biddulph	01782 515152								●		
ASD metal services - Bodmin	01208 77066								●		
ASD metal services - Cardiff	029 2046 0622								●		
ASD metal services - Carlisle	01228 674766								●		
ASD metal services - Daventry	01327 876021								●		
ASD metal services - Durham	0191 492 2322								●		
ASD metal services - Edinburgh	0131 459 3200								●		
ASD metal services - Exeter	01395 233366								●		
ASD metal services - Grimsby	01472 353851								●		
ASD metal services - Hull	01482 633360								●		
ASD metal services - London	020 7476 0444								●		
ASD metal services - Norfolk	01553 761431								●		
ASD metal services - Stalbridge	01963 362646								●		
ASD metal services - Tividale	0121 520 1231								●		
Austin Trumanns Steel Ltd	0161 866 0266								●		
Ayrshire Metal Products (Daventry) Ltd	01327 300990	●									
BAPP Group Ltd	01226 383824									●	
Barnshaw Plate Bending Centre Ltd	0161 320 9696	●									
Barrett Steel Ltd	01274 682281								●		
BW Industries Ltd	01262 400088	●									
Cellbeam Ltd	01937 840600	●									
Cellshield Ltd	01937 840600							●			

Steelwork contractors for bridgework

RQSC
The Register of Qualified Steelwork Contractors Scheme

The Register of Qualified Steelwork Contractors Scheme for Bridgeworks (RQSC) is open to any Steelwork Contractor who has a fabrication facility within the European Union.

Applicants may be registered in one or more category to undertake the fabrication and the responsibility for any design and erection of:

FG Footbridge and sign gantries
PG Bridges made principally from plate girders
TW Bridges made principally from trusswork
BA Bridges with stiffened complex platework (eg in decks, box girders or arch boxes)
CM Cable-supported bridges (eg cable-stayed or suspension) and other major structures (eg 100 metre span)
MB Moving bridges
RF Bridge refurbishment
AS Ancilliary structures in steel associated with bridges, footbridges or sign gantries (eg grillages, purpose-made temporary works)
QM Quality management certification to ISO 9001
SCM Steel Construction Sustainability Charter (● = Gold, ● = Silver, ● = Member)

Notes
(1) Contracts which are primarily steelwork but which may include associated works. The steelwork contract value for which a company is pre-qualified under the Scheme is intended to give guidance on the size of steelwork contract that can be undertaken; where a project lasts longer than a year, the value is the proportion of the steelwork contract to be undertaken within a 12 month period.
Where an asterisk (*) appears against any company's classification number, this indicates that the assets required for this classification level are those of the parent company.

BCSA steelwork contractor member	Tel	FG	PG	TW	BA	CM	MB	RF	AS	QM	SCM	Contract Value [1]
B&B Bridges Ltd	01942 676770	●	●	●	●	●	●	●	●	✓		Up to £1,400,000
Briton Fabricators Ltd	0115 963 2901	●	●	●	●	●	●	●	●	✓		Up to £3,000,000
Cairnhill Structures Ltd	01236 449393	●	●	●	●			●	●	✓	● (Gold)	Up to £2,000,000
Cleveland Bridge UK Ltd	01325 502277	●	●	●	●	●	●	●	●	✓	● (Silver)	Above £6,000,000
Kiernan Structural Steel Ltd	00 353 43 334 1445	●	●	●	●			●	●	✓	● (Silver)	Up to £800,000
Mabey Bridge Ltd	01291 623801	●	●	●	●	●	●	●	●	✓	● (Gold)	Above £6,000,000
Nusteel Structures Ltd	01303 268112	●	●	●	●	●		●	●	✓		Up to £4,000,000
Painter Brothers Ltd	01432 374400	●		●					●	✓	● (Silver)	Up to £6.000,000
Rowecord Engineering Ltd	01633 250511	●	●	●	●	●	●	●	●	✓	● (Gold)	Above £6,000,000
S H Structures Ltd	01977 681931	●		●	●	●			●	✓	● (Silver)	Up to £3,000,000
SIAC Butlers Steel Ltd	00 353 57 862 3305	●	●	●	●	●			●	✓	● (Member)	Above £6,000,000
TEMA Engineering Ltd	029 2034 4556	●	●	●	●	●	●	●	●	✓		Up to £1,400,000*
Varley & Gulliver Ltd	0121 773 2441	●						●	●	✓		Up to £4,000,000
Watson Steel Structures Ltd	01204 699999	●	●	●	●	●	●	●	●	✓	● (Gold)	Above £6,000,000
Non-BCSA member												
ABC Bridges Ltd	0845 0603222	●								✓		Up to £100,000
A G Brown Ltd	01592 630003	●						●	●	✓		Up to £800,000
Allerton Steel Ltd	01609 774471	●	●	●	●	●	●	●	●	✓		Up to £1,400,000
Carver Engineering Services Ltd	01302 751900	●	●	●	●		●	●	●	✓		Up to £2,000,000
Cimolai Spa	01223 350876	●	●	●	●	●	●			✓		Above £6,000,000
Concrete & Timber Services Ltd	01484 606416	●	●	●		●	●		●	✓	● (Member)	Up to £800,000
Donyal Engineering Ltd	01207 270909	●						●	●	✓	● (Member)	Up to £800,000
Four-Tees Engineers Ltd	01489 885899	●	●	●	●		●	●	●	✓	● (Member)	Up to £2,000,000
Francis & Lewis International Ltd	01452 722200							●	●	✓	● (Member)	Up to £2,000,000
Harland & Wolff Heavy Industries Ltd	028 9045 8456	●	●	●	●	●		●	●	✓		Up to £6,000,000
Hollandia BV	00 31 180 540540	●	●	●	●	●	●	●	●	✓		Above £6,000,000
Interserve Project Services Ltd	0121 344 4888							●	●	✓		Above £6,000,000
Interserve Project Services Ltd	020 8311 5500	●	●	●	●		●	●	●	✓		Up to £800,000*
Millar Callaghan Engineering Services Ltd	01294 217711	●						●		✓		Up to £800,000
P C Richardson & Co (Middlesbrough) Ltd	01642 714791	●						●	●	✓		Up to £3,000,000*
The Lanarkshire Welding Company Ltd	01698 264271	●	●	●	●	●	●	●	●	✓	● (Member)	Up to £2,000,000

Company name	Tel	1	2	3	4	5	6	7	8	9	SCM
CMC (UK) Ltd	029 2089 5260							●			
Composite Metal Flooring Ltd	01495 761080	●									
Composite Profiles UK Ltd	01202 659237	●									
Computer Services Consultants (UK) Ltd	0113 239 3000		●								
Cooper & Turner Ltd	0114 256 0057									●	
Cutmaster Machines UK Ltd	01226 707865					●					
Daver Steels Ltd	0114 261 1999	●									
Development Design Detailing Services Ltd	01204 396606			●							
Easi-edge Ltd	01777 870901							●			●
Fabsec Ltd	0845 094 2530	●									
FabTrol Systems UK Ltd	01274 590865		●								
Ficep (UK) Ltd	01924 223530					●					
FLI Structures	01452 722200	●									
Forward Protective Coatings Ltd	01623 748323						●				
Hadley Rolled Products Ltd	0121 555 1342	●									●
Hempel UK Ltd	01633 874024						●				
Hi-Span Ltd	01953 603081	●									●
Highland Metals Ltd	01343 548855						●				
Hilti (GB) Ltd	0800 886100									●	
International Paint Ltd	0191 469 6111						●				●
Jack Tighe Ltd	01302 880360						●				
Jamestown Cladding and Profiling	00 353 45 434288	●									
Kaltenbach Ltd	01234 213201					●					
Kingspan Structural Products	01944 712000	●									●
Leighs Paints	01204 521771						●				●
Lindapter International	01274 521444									●	

Company name	Tel	1	2	3	4	5	6	7	8	9	SCM
Metsec plc	0121 601 6000	●									●
MSW	0115 946 2316	●									
National Tube Stockholders Ltd	01845 577440								●		
Northern Steel Decking Ltd	01909 550054	●									
Panels & Profiles	0845 308 8330	●									
John Parker & Sons Ltd	01227 783200								●	●	
Peddinghaus Corporation UK Ltd	01952 200377					●					
Peddinghaus Corporation UK Ltd	00 353 87 2577 884					●					
PMR Fixers	01335 347629	●									
PP Protube Ltd	01744 818992	●									
PPG Performance Coatings UK Ltd	01773 837300						●				
Prodeck-Fixing Ltd	01278 780586	●									
Rainham Steel Co Ltd	01708 522311								●		
Richard Lees Steel Decking Ltd	01335 300999	●									●
Schöck Ltd	0845 241 3390	●									
Structural Metal Decks Ltd	01202 718898	●									●
Studwelders Composite Floor Decks Ltd	01291 626048	●									
Tata Steel	01724 404040				●						
Tata Steel Distribution (UK & Ireland)	01902 484100								●		
Tata Steel Service Centres Ireland	028 9266 0747								●		
Tata Steel Service Centre Dublin	00 353 1 405 0300								●		
Tata Steel Tubes	01536 402121				●						
Tekla (UK) Ltd	0113 307 1200		●								
Tension Control Bolts Ltd	01948 667700									●	
Wedge Group Galvanizing Ltd	01909 486384						●				